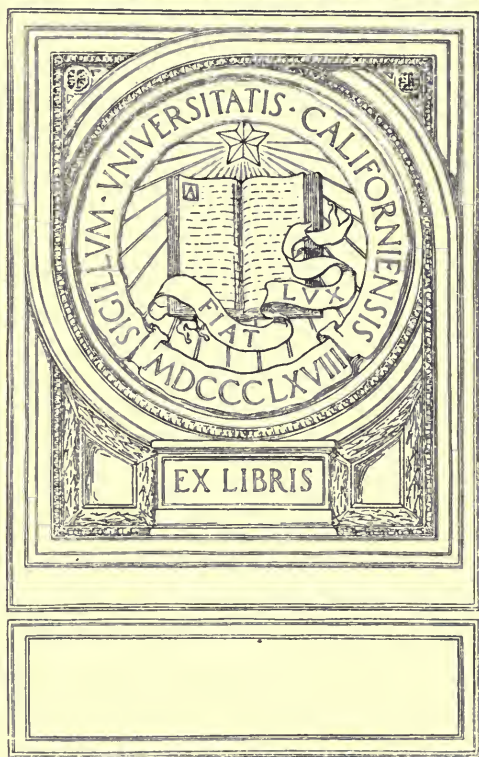


UNIVERSITY OF CALIFORNIA
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FROM THE LETTER-FILES OF S. W. JOHNSON



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FROM THE LETTER-FILES OF S. W. JOHNSON

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"The Daguerreotype process—the first
practical method of taking pictures by the
chemical action of light—was invented by
Daguerre and Niepce in France and made
sensitive enough for taking human portraits
by Dr. Draper of New York, 1840.

This 'Daguerreotype' was taken with elec-
tric-arc-light at the instance of Professor B.
Silliman, Jr., in 1850 or 1851 by a New Haven
photographer in the Yale College Laboratory
—in, I think, the summer of 1851—

S. W. JOHNSON, Jan. 1897.

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S. W. JOHNSON, Jan. 1897."

FROM THE LETTER-FILES OF S. W. JOHNSON

PROFESSOR OF AGRICULTURAL CHEMISTRY
IN YALE UNIVERSITY, 1856-1896

DIRECTOR OF THE CONNECTICUT AGRICULTURAL EXPERIMENT
STATION, 1877-1900

EDITED BY HIS DAUGHTER
ELIZABETH A. OSBORNE



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TO

THE BUILDERS OF THE BROAD, FIRM HIGHWAYS THAT
NOW CROSS THE LONELY PLACES WHERE PROFESSOR
JOHNSON TOILED AND TO THE MAN WHOSE WORK
WAS THE JOY OF HIS OLD AGE

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PREFATORY NOTE

I acknowledge with gratitude the helpful kindnesses of many busy men. In the preparation of the narrative supplementing these letters of my father and his friends I have availed myself of material gathered from the writings of men of science whose names either figure in these pages or are well known to present-day workers in our Agricultural Colleges and Stations. In a few instances I have borrowed not only the spirit, but the letter of their text—lest through clumsy transposition an expression should lose its clearness. Whenever possible, I have asked permission for my action. The cordial assent given in each case emboldens me to request the few with whom I have been unable to communicate to accept my thanks and this general acknowledgment.

E. A. O.

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FROM THE LETTER-FILES OF S. W. JOHNSON

INTRODUCTION

The newness of much that seems to us to have always been comes at times as a surprise, and sets our minds to work in an effort to realize the environment of our immediate forebears at a time when ideas now accepted as fundamental axioms were the glad tidings of a new gospel of knowledge and truth. Only sixty years ago, a little band of friends, born in America and trained in good part in the universities of Germany, was laying here in the new world the foundations of the great work in agricultural science which is being carried on today by men born in America and well trained in American universities. Workers, their methods and their aims make up the early history of every branch of human endeavor. The way in which they opened up the field interests the workers of today. These early enthusiasts looked into the future confident that their work was good and that it ought to be done; they believed that without chemistry it never could be done; they sought so to raise the standards and improve the methods of chemists that a chemically demonstrated fact should stand unassailable. They had studied under pupils of the men who saw chemistry evolve from alchemy. Some of them lived to follow with admiration the brilliant achievements of such men as Gibbs, van 't Hoff and Arrhenius, which are today establishing the fundamental principles of biochemistry on which agricultural practice rests.

From the portrait of a painter looks out the keen eye of the artist. As one gazes into it all the imper-

fection of the man vanishes, only the artist soul remains; and in the portraits of all who have painted truly, it is the same clear, beautiful eye, the expression of the gift of imagination. The man who labors with faith and enthusiasm for truth in science must be endowed with this gift of imagination, must look out into nature with the artist's eye. His success in learning the secrets of nature is in proportion to his gift and the use he makes of it. Hence comes a paradox. The so-called materialistic man of science is spiritually a painter, a poet, an evangelist consecrated to the cause of truth. Therefore, he, too, is set a little apart from the ordinary way and must, like the prophet, the painter and the poet, take heed lest he travel so far ahead that those not of his own craft may fail to understand him and his message.

Samuel William Johnson was one of that small group among the chemists of America who, two generations ago, undertook to extend and develop laboratory instruction in chemistry and to apply this science to the industries of the country. Among these men, most of whom passed away before him, few left a greater impress on American chemistry or American chemists than did Professor Johnson. His whole life was devoted to training workers in this field, to making others realize what chemistry could do for them, and to developing institutions and methods to extend the knowledge of chemistry, and make it available to those engaged in productive occupations. The results of his efforts are far better appreciated today, when the returns are so apparent, than they were during the years of his greatest activity, when he was patiently

struggling against the conservatism of so-called practical men, who could only with difficulty be persuaded to make the beginning which was essential to demonstrate the truth he was trying to teach them.

His was an example of a form of high public service which the man of scientific training can render to his country and humanity. His broad, sure grasp of chemical problems and his prophetic appreciation of the advantages to be gained by the application of the science of chemistry to the problems of agriculture, made him a power in the campaign of education which finally brought about the establishment of the agricultural experiment station as a national institution; an achievement which ranks as the most substantial contribution yet made by the United States to applied science.

A scholar, a clear thinker, a man of discriminating mind, he had an unusual capacity for remembering where and when scientific papers were first published, and was a living index to all things pertaining to chemical literature in a day when modern library short-cuts to knowledge were not. He possessed the ability to discuss scientific facts and theories simply and effectively, and could impress on untrained hearers distinctions between facts, theories and working hypotheses, presenting the matter in hand with great breadth of view and winning followers for his cause through his own love of his subject. From boyhood he was a voluminous writer for the agricultural press, his chosen field of missionary activity. It is interesting to note that in one of these earliest writings he sets forth with clearness the need for the agricultural experiment station in America. For twenty years

prior to the opening of the first state experiment station in this country, he—as chemist to the Connecticut Agricultural Society and to the Connecticut State Board of Agriculture—was doing for the community the essential work of an agricultural experiment station, gaining by means of his personal reputation the confidence of farmers and familiarizing them with the worth and necessity of the institution which was soon to be founded in Connecticut through his efforts. He gave them not only results, but an intelligent understanding of their application and meaning, thus arousing in the early days of this new work an interest which went far towards making possible its development and spread to other states. That his work met the requirements and established popular confidence is a matter of history. As teacher, writer and investigator, and as guiding hand in the administration of the first experiment station, Professor Johnson wielded an influence exercised by few scientific men of his time, and was a potent factor in developing thought and understanding along the line of the relations of science to agriculture. His writings brought together and gave form to the isolated facts bearing upon that subject; continuing without interruption for more than fifty years, they carried his name beyond the boundaries of this continent. His greatest work was done before the experiment station movement became national and before popular sentiment had embraced the idea of a system of institutions devoted to scientific work in the interests of practical agriculture. His labors, his studies and his public utterances prepared the way for the reception of this idea; and the example of usefulness furnished by the

station under his direction was a powerful stimulus to its propagation and fruition in other states.

By developing details of station work and methods, by establishing high standards of fair dealing both with the farmer and with those who supplied him, and by inspiring all associated with him with high ideals of scientific work, he did more than any one other man to make the experiment stations of the country the useful and successful institutions they are today. In his old age he found himself, in the words of a friend, "In the rare and privileged position of having assisted almost at the sowing of the seed of the science of agricultural chemistry and of living to see it grow into a great, big tree."

CHAPTER I

CHILDHOOD AND EDUCATION IN AMERICA

Jacob Johnson of Wallingford was not the first of his family in this country. Two generations of his forebears may be found on the genealogical lists; but to their descendants these earlier Johnsons are only names. The tradition handed down by grandmothers and great-aunts has always begun with Jacob of Wallingford, about whom tangible knowledge has survived as one of the "West Farmers" of that part of Wallingford which is now Cheshire, Connecticut, where he owned many acres and reared many children, living long and respected in that rural community. One of his sons, Abner, was a merchant, a man of some prosperity and captain of the Wallingford train-band at the time of the French and Indian War. His son, Jacob Johnson, married Esther Hotchkiss, of whose wisdom, sagacity and ability many tales are still extant. When a messenger came to summon her husband, who was home on furlough, back to service in the Revolutionary War, she hastened to the field where he was ploughing, bade him farewell, lifted the reins from his neck and, placing them around her own, called her small son to help her finish not only the furrow but the field. She lived to a revered old age and saw four generations of her descendants. With a family of fourteen children, she had fair field for the use of all her "faculty" and self-reliance. Her second daughter, Amelia, married Daniel Potter, a

man of large means for that day, who lived at Kingsboro' in the then new country of Northern New York State. Gradually the rest of Jacob the second's family came to live near them and her parents lie buried in the old cemetery at Kingsboro'.

Being childless, Daniel and Amelia, "Uncle and Aunt Potter," as they were called, brought up and practically adopted her young brother, Abner Adolphus, the twelfth of Jacob and Esther Johnson's family. In time, Abner Adolphus Johnson succeeded his brother-in-law, Daniel Potter, as a merchant in Kingsboro', New York, where he also kept the tavern and owned and managed a large farm. At the age of thirty-two he married Annah Wells Gilbert, like himself descended from pure colonial stock. She had been brought, when two years old, to New York State by her parents, who emigrated with a band of kinsfolk and neighbors from Hebron, Connecticut. She trained her family in accordance with the best traditions inherited from Puritan ancestors, teaching them to value character and to feel a deep responsibility for the use they made of their time and opportunities. In the names of her eight children she commemorated her own lines of descent—Gilbert, Wells and Brainerd—and Samuel Johnson's name was first given him in honor of his grandfather, Judge Samuel Gilbert; later in his boyhood the middle name of William was added in remembrance of the many of his father's kin who had borne the names of Samuel and of William.

Abner Adolphus Johnson lived in Kingsboro' until 1834. Then, his wife not being strong and he himself suffering from nervous ills brought on by a too sedentary life, he retired from business and went back to

the soil, investing his property for the most part in farm lands in the fertile valley of the Deer River in Lewis County, New York, then recently opened for settlement. Here he lived in patriarchal manner, his hospitable roof covering not only his large immediate family, but nephews and nieces, brothers and sisters, distant kinsfolk and hired laborers. "Uncle Abner's Mansion" was home to many, and all were welcome inmates. This house at Deer River was built when his third son, Samuel, whose life-work is followed in this volume, was four years old; and for thirty years it was home to an ever increasing family circle, united by unusually strong bonds of mutual affection. The daily life was simple and frugal, all were industrious, much store was set on things of the spirit; there was deep love of truth and much seeking for broader knowledge.

Educational opportunities were eagerly embraced; we find Samuel Johnson at the age of eleven a pupil in the same classes with his elder brothers and sister at the Lowville Academy, where for fully fifteen years some one or more of this large family was in attendance. Lowville, although only a few miles from home, was too far to go and come daily, so the children boarded there during term time, returning in vacations to Deer River. They were all good students, and Samuel was allowed to keep pace with the others as far as he was able.

In 1842 Samuel Johnson was a small, dark-haired boy whose eyes, as yet unhelped by the powerful lenses he used in later years, gave him little information about objects more than a few feet away. Any and every thing in print on which he could lay his hands he mas-

tered at once, but his indifference to matters outside of books was the despair of his family. The love and sympathy of his elder sister, her comprehension of his intellectual needs, aided his development, and the mutual devotion of their childhood endured for over seventy years. In his family as a whole he was singularly blessed. The paths of learning into which he was irresistibly attracted were strange and untried in their eyes. It argues a surprising breadth of mind on the part of a man of Mr. Abner A. Johnson's training and environment that he should have finally consented, and after consenting consistently encouraged his son in entering upon a life-work so novel and untried; for in his belief there were, except he be called to the holy ministry, just three things safe and profitable for a man to engage in, law, medicine and farming. Our cities and their complex activities were lightly regarded by him, living in what was then a frontier country where all necessary business was carried on by men whose main investments were in the soil.

Before leaving school in 1846, Samuel Johnson acquired some knowledge of Latin and a little Greek, more algebra, and as much of physics, botany and chemistry as opportunity afforded. In his last year at the Lowville Academy, chemistry became the absorbing interest of his mind. He gives this record of the first great event in his intellectual life, written in the cover of an old "Fresenius," published in 1844—the entry is dated February 1905:

This book came into my possession fifty-nine years ago while I was a student in Lowville Academy, Lewis Co., Northern New York. I there became fascinated with Chem-

istry through the brilliantly illustrated lectures of the Principal, David Porter Mayhew, who made me his assistant, and (I believe) brought me this volume from New York City where he visited during his long vacations. In my own Laboratory at Deer River I prepared most of the pure reagents, and as far as possible worked through the qualitative courses described in this excellent work.

In the winters of 1846-47 and 1847-48, Samuel Johnson had charge of district schools near his home. The sixteen-year-old teacher learned quite as much as did his pupils, and the habit of intellectual self-reliance, which was a marked characteristic of his later years, may well have had its beginning in the necessities of his position as a teacher of boys generally his seniors, and nearly always his physical superiors. While teaching these elementary classes, he began the lavish buying of standard treatises on different branches of science, which became the habit of his life. By nature a student, he assimilated the contents of all such additions to his library with thoroughness. Brought up in close association with members of the bar and others who, as Justices of the Peace, were busily occupied with court cases which today would be placed in the hands of lawyers, he unconsciously adopted their methods of thought and their phraseology; and from infancy his tongue was trained in the English of the King James Version.

His first appearance in print was in August 1847, when he said, after a discussion of the scientific point which was the occasion of the article: "When the spirit of inquiry and trust pervades the whole mass of the agricultural community, dissipating prejudice and willing ignorance, then it may be expected that science

‘will do her perfect work,’ and what perfection may we not anticipate from enlightened practice under her auspices?’” Having set himself, at this early date, his text, he preached from it at every opportunity during the next fifty years. The need for conservation of national resources was unconsidered in this country in 1847. We were, as a people, newly arrived and spent our riches lavishly. A curious shortsightedness led those with culture derived exclusively through the classical curriculum of colleges to confuse rusticity with vulgarity, to regard the gas-light flickering at the corner of a village street rather than the steady beams of the stars seen over a frosted field, to hold that he who communed with nature must inevitably wear muddy boots and fail to rise above their contemplation. Men were crowding into towns; the rapid multiplication of manufactures and railroads, giving opportunity for the accumulation of wealth, drew away from the farm the energetic and ambitious who were too intent upon piling together bricks and mortar to consider the importance of increasing our agricultural resources. With the heedlessness of youth, the whole country seemed to admire prodigality, to scorn economy, foresight and thrift. This boy was sixty years ahead of the popular appreciation which today sets scientific agriculture and scientific agricultural education in a place of first importance as economic necessities to our national existence.

In 1848, Samuel Johnson became the possessor of a private laboratory. His father put at his disposal a building on the place at Deer River with the use of laborers and a carpenter to fit it up for his purposes, caused running water to be brought into it, and gave

him fifty dollars for the purchase of chemicals, so that he might pursue his studies by himself. His invalid mother, to emphasize her interest in his undertaking, gave him, to melt up for reagents, her wedding teaspoons, old and thin and dented by the hard usage of many children. Self-education in his own laboratory, through unaided experimentation and the systematic use of text-books, developed confidence and the habit of independent logical thought. He learned to attain the best possible methods of work by rejecting those which on thorough testing did not give uniformly certain results, and to eliminate all conclusions based on assumption.

This private laboratory had been lovingly furnished, and his devotion to science was approved as an interest, but the whole family felt that he should fit himself for some definite and recognized occupation. His father, especially, unconvinced of the likelihood of a professional future for his son in chemistry, wished him to study for the practice of law or medicine. Unwilling to abandon his own dream of a purely scientific life-work, Samuel Johnson, in the fall of 1848, secured a position as instructor in the Flushing Institute at Flushing, Long Island, hoping to demonstrate that he could support himself by teaching and at the same time read and study along scientific lines.

The letter of earliest date in the bundle which his mother kept in her little red trunk is the following:

Flushing Institute, Dec. 12, 1848.

Dear Friends at Home—I have come to a desperate conclusion to spoil the beauty of this sheet. I am about to address a letter to everybody in particular and nobody in

general and *vice versa* if I may be allowed the expression. I will give a history of "operations and things" here. The school numbers about 70 boys, no girls except Emily and the *helps* and they don't attend school. Old Ezra Fairchild, the good jolly old gentleman, is *Head Principal*. Beside him are Mr. Elias Fairchild, Mr. Bates, Mr. Babbit, Mr. Raone (French Teacher), and MR. *Johnson* as *Instructors*. Mr. Johnson, as I wrote in my last, has a salary of \$20.00 per month in addition to the comforts of a good home, etc., etc.—Teachers and students all lodge and eat under the same roof.—A Day's Procedure: At 7 o'clock Mr. Corwin or somebody else goes through the halls ringing a huge bell that drums sleep to California, and at 8 o'clock the bell rings for Chapel when the whole family collects in the Chapel and spends 15 or 20 minutes in religious exercises, and generally Father Ezra lectures the unruly ones. . . . This morning some fellows, gentlemen if we can judge from coat and boots, having got up late did not present themselves in Chapel, whereupon Mr. Fairchild told them to go back to bed and stay all day. (Three of them refused to do so and started off home to New York city, but before night came back and went to bed.) Soon after Chapel, breakfast rings. . . . I have 20 students under my care, in an upper school room. Writing, Spelling, Arithmetic, Grammar, Geography, are all the studies I teach at present. Just imagine Sam Johnson. . . . One fine young man lends him a watch, since the poor dog can't afford to own one, and he might keep the class a fortnight without one. That's enough. Don't think any more about "Sam Johnson," or "Doctor." There is no such man here. Mr. Johnson is the feller. . . .

Mr. Johnson was most happily situated at Flushing, and would have been entirely contented had he not had a definite ambition for the future, to the fulfilment of which he longed to devote himself. Teaching occupied nearly all his time; hours for study were far too

few. He had decided once and for all to become a chemist. On February 24, 1849, he wrote home:

Dear Father.— . . . If I stay here it will undoubtedly be with a salary higher than at present. . . . As to California, I think it may do for those who desire to grasp emptiness in the midst of confusion, and when I am caught going thither, I am found stepping on my own ears.

It is not one of the most encouraging thoughts to entertain, that many years must elapse before I can acquire the education that I need to begin life with. To become a chemist requires not only intense and laborious application to study, but the expenditure of a great deal of time and a not inconsiderable amount of money. How difficult then to accomplish the required labor when so much time is necessarily devoted to earning the means for supporting expenses. And when I behold myself outstripped by others simply because they have means, I am strongly tempted to repine at the partiality of fortune, but when I read the achievements of Davy, Faraday, Scheele, Klaproth, Liebig, Berzelius and a host of others who have elevated themselves from poverty to the highest stations and shed a halo of glory upon their own names and the age that produced them, by their zealous, self-denying struggles after truth, how am I encouraged to tread cheerfully the path of science, though alone and exposed to the sneers of the vulgar and ignorant—yes, and toil on through the obstacles that impede my progress undaunted and persevering,—hoping for a good time in the future. What shall be my future course I hardly know. If I remain here I shall carry on my studies and practice as far as possible, but I cannot do much. When I have accumulated a few hundred dollars, I will take a course of instruction in Yale College Laboratory, but until then how long! But my soul gather thee for the conflict, for the toil, since great is the reward. Enough said, therefore I—but I came near forgetting the stockings, shirts, etc. and of these I can only say as long as I have money I shall want

neither— Respects to all the folks, while I remain, Affectionately, the same old sixpence, S. W. Johnson.

In “Analyses of Limestone,” published April 1849, Mr. Johnson makes for the first time his plea, afterwards often reiterated, that scientific workers should “reason and labor without prejudice” rather than allow their results and methods to be controlled by the “reputation of some prominent individuals.” He states:

It becomes, therefore, the interest as well as the duty of him who would bring science to the aid of agriculture, to make every labor as complete as possible, and especially to avoid the dogmatic introduction or support of untested theories and that narrowminded ignorance which entertains the possibility of making any one discovery which shall remedy the failings of the present practice.

He then continues:

Much is to be hoped from the labors of scientific men, conducive to the interests of agriculture. The farmer has to deal with nature; to follow intelligently his business supposes a knowledge of her laws. These laws are the professed object of the chemist’s inquiry, and hence follows,—what experience has a thousand times established,—the ability of the chemist to fashion his practice so as best to assist and imitate nature, and consequently to gain from her the greatest amount of benefit.

Farmers’ sons must be instructed in Natural Science. The mind is the great instrument and this mind must be cultivated. All are familiar with the difference between the crab-apple and the beautiful, grateful fruit that yearly adorns our orchards; no less difference is there between the mind native and cultivated. There is no better means of a speedy

and harmonious development of intellectual, physical and moral powers than the study of nature. Do our great chemists, geologists, etc., fall behind mathematicians and classical scholars in mental acumen or profundity? They certainly occupy a greater rank in view of the utility of their labors. The natural sciences offer this decided advantage over every other study to the young farmer, that they are of direct application to the daily concerns of his life. Let him then be more concerned to know the nomenclature of chemistry than the Greek alphabet. Let him study Liebig before Virgil, and Boussingault before Horace. Not that I would cast any reproach on the study of the classics, but I would have education adapted to the wants of the educated. Every farmer should be thoroughly acquainted with chemistry, botany, zoology, etc., as affecting the principles of his art. Not that every farmer should be a chemist,—that would be impossible—but many possessed of natural tact might render themselves sufficiently expert in analysis to materially benefit their business without interfering with it. The schools of practical chemistry that are springing up in our midst should be well supported by our farming community.

The reason why so few young men of talent and intellectual promise are found engaged in cultivating the soil is that agricultural pursuits, as commonly practised and understood, offer no gratification to the mind. The proper application of science to husbandry will remove this evil, and so soon as provisions are made for the education of farmers, equal to those now furnished for physicians and lawyers, we shall behold the intellectual as well as the physical energies of our country devoted to the perfection of agricultural processes. . . . “Blessed are ye that sow beside all waters, that send forth thither the feet of the ox and the ass.”—Isaiah.

Having spent the spring vacation at home, Mr. Johnson wrote on his return to Flushing, on May 8, 1849:

Dear Father,—I left Lowville Thursday morning at 8 o'clock and staged it to Rome where I arrived at 3 o'clock P.M. At 9 we left in cars and reached Albany at 3 o'clock A.M. Friday I breakfasted for the sake of my baggage at Stanwix Hall, and at 7 o'clock was sailing off in the steamer Confidence. She was the only boat running that day, and sang up to the tune of \$1.50 for passage. I had a very pleasant ride down the river. My eye was greeted with lots of green things, many willows and also fruit trees were in blossom. When we started it rained a little, and a rather strong south wind made it unpleasant to look about, but when we got down 40 or 50 miles it became much milder, the sun shone, and I mounted myself upon the capstan on the prow of the boat, and heartily enjoyed the magnificent scenery which I was enabled to appreciate to some extent intelligently by aid of a small book I purchased, entitled "Wilson's Illustrated Guide to the Hudson River," which gave a map of the river and notices of the important towns, etc. At 5 P.M. we reached the dock in New York, and I rode down to Fulton Market Slip to take the Flushing boat, but in the midst of a squabble with a parcel of negroes about my baggage and pay, the boat sailed, and I wheeled up to Lovejoy's Hotel to pass the night. Lovejoy's is a huge building in Park Row just opposite the Astor House, and is carried on in just the style to suit me. They charge .50 cts. for lodging, and a person may take meals or not as he chooses, and no questions asked. The Refectory is in the basement where a person may at any time of day call for what he wants, and is carried on as if it were a separate concern. A good meal of ham and eggs, enough for any man, for .25 cts. Sat. I ran about the city, visited the Nat. Academy of Design, a glorious collection of paintings, and the American Museum, and at 1/2 past 4 sailed for Flushing where I was literally recv'd with open arms by Unele Ezra and the rest. The teachers are all back, and now—Tuesday, 11 O'clock A.M.—25 students. Many more are expected all through the week. . . . Please send

the *Northern Journal* EVERY WEEK and write soon.
Obediently, S. W. Johnson.

His loving interest in the education of four little sisters is shown in a letter of even date to his sister, Esther, then ten years old. "The Doctor" was his own nickname in the family, "the Judge" and "the Squire" were respectively two elder brothers, grown men at this time.

I mail with this note a small, but very useful and I think it will prove to you a very interesting, book "First Lessons in Botany" by Alphonso Wood, Master of Arts. I hope you and the rest of the little sisters are all quite well and enjoying what little spring Deer River can afford. The school is getting very well filled, and in a few days I shall teach classes in Chemistry, Botany, Nat. Philosophy and perhaps Astronomy.

You will doubtless feel disposed to study your little Botany immediately, and since I am "the Doctor," and therefore am understood to know science, you will receive from me a little advice as kindly as it is offered. Now in the first place sit down and count the cost. Botany is not a *very* easy study, and it will try your patience no doubt to some extent, but just resolutely make up your mind to acquire a thorough knowledge of it, and then study hard to accomplish the good purpose. You cannot perhaps study and recite it in school, because your teacher has not probably an acquaintance with the science, but if she has you can commence business at once,—and so you can at any rate, but it will be hard work I fear, nevertheless you can do it and now for the plan. Get up at 4 o'clock (going to bed at 8 o'clock), or as early as any one in the family, get dressed, then wash, etc. Do all this in a lively, sprightly manner, assist in whatever household duties may fall to your lot, until 5 o'clock, then Ma must allow you an hour to study Botany. Take up the Book and read the title page. It is only "First Lessons," and since there [is] a

great deal more to know about Botany than this little volume contains, you must be very diligent to learn all there is in it so that you can go on with larger works. Then read the beautiful extract from Dr. Darlington on next page, go on with suggestions to teachers. Then directions for pronunciation, the Judge will explain by reference to some terms in the body of the book the use of accents. Then learn *thoroughly* the Greek and Latin numerals. You *cannot* go a step without this knowledge. This well done, read carefully over the Abbreviations and Signs, so that you may always know where to look for them. Lesson 1st. then may occupy your attention. Let it not pass until you know it *perfectly*, and can readily answer every question. Whenever any part of a plant is instanced in the book you must refer to the figure and, if possible, procure a corresponding specimen. For example, to illustrate Fig. 2, page 14, plant a *bean* or *cucumber seed*, and when it comes up dig it and carefully examine its parts, and associate with the appearance of its parts their names; thus the commission of the many terms to memory is greatly aided. Learn accurately the difference between terms nearly similar, as *Hirsute*, *Scabious*, *Tomentose* and so on. And be very careful, I repeat it, to find nature and *see* the part or peculiarity described. Thus in illustration of fig. 7, page 15, procure a leaf of the *choke* cherry and notice upon the *petiole* or stem of the leaf 2 or 3 little hairs with glands on the top. Lesson 1st *learned*, less. 2d may be taken up. Now always look well to the heading of a chapter. *Classification* introduced, think what classification means, and then note that the lesson treats of *grand* divisions, that is the largest divisions that can be made. Fig. 9 represents the wake robin or *beth* root. Have the plant before you when you study. You can use my *Botany Box* to collect. Shorten the string so you can carry it well. As you go on with the various *divisions* of leaves, roots, flowers, etc., get as many of each class as possible to examine, and the labor of retaining so

many names will be comparatively slight. To aid you somewhat I have written in the Book examples of plants you know, to which you can refer when you are unacquainted with the plant the book mentions. After a little practice you will get along well enough. You must not be in too great a hurry to get along, but get everything thoroughly as you go along. It may be hard and seem tough, but we must work to grow strong. And if you labor through this and get it perfectly, you can answer questions that perhaps no other person in Lewis Co. may be able to do.

You will have so improved as to be able to take up other studies, as Chemistry, Astronomy, etc. etc., and learn them with tolerable ease and will find your perseverance and patience drawn out to a wonderful extent, so that you will be less vexed with even the common cares of life. When you have finished this Book it will [*be*] my care to provide you with [*a*] larger.

In June, he writes to quiet the anxiety of the family, as voiced by his elder sister, Sarah, over the prevalence of cholera in New York. Evidently he has been more concerned with his own plans for the future than with rumors of epidemics:

Dear Father,—I recv'd Sarah's letter Sat. night and now return an answer concerning Cholera, etc. There have been no well characterized cases in Flushing. We have no alarm upon the subject. The school goes on as usual, only about 60 students. I like things in general, and enjoy myself much better than I did last winter. I teach an excellent class in Chemistry, and shall soon commence giving instruction in practical Chemistry, or Blowpipe Manipulation, to three smart young men. I wrote some time since to Prof. Horsford of Cambridge University for information respecting the expenses of studying with him. They are as follows per annum.

Tuition and supplies . . .	\$200.
Board	100.
Washing	10.
Room rent	30.
Lecture fees	20.
Clothing, et ceteras . . .	40.
<hr/>	
	\$400.

The Professor stated that several young men were working through their course, supported by money borrowed on life insurance, and thought they would succeed well— And having reflected upon the subject, I am becoming more and more anxious to go to Cambridge next fall. The Prof. thinks that if I could arrange to stay there a year some means would offer for self-support. Although I am doing pretty well, and well enough had I no education yet to acquire, yet I think that one or two years' study at Cambridge would enable me to earn \$3.00 where I now earn one. I have almost reached the age of 19, and feel that I must soon begin in earnest if I would make myself master of the science that is every year almost doubling its extent. If at the age of 21 I be a good analyst, I shall undoubtedly be able to make my living and pay off debts contracted in getting education. Dominic Tyler was \$900 in debt when he left college, and I hardly know a collegiate that has not gone through his course upon more or less borrowed money. I hate the idea of contracting debt, yet the idea of it furnishing me with increased capacity for acquiring pecuniary means is encouraging; on the whole, could I do it legally and were I left to my own discretion, I should borrow \$300. and go to Cambridge next Oct. The idea of being so much longer ignorant of what I have so long desired is "hope deferred that maketh the heart sick." The expenses are so great that I cannot hope to go with less than \$300. besides that which I have earned. What does Pa think?

22 . LETTER-FILES OF S. W. JOHNSON

. . . Love to all the folks, and thanks to Sarah for her letter.
I remain, affect'ly, S. W. Johnson.

Quiet consideration of the relative opportunities offered by Harvard and Yale led him to go, in October, to New Haven to look over the ground there. A personal interview with Professor Norton settled his future course clear in his mind, and he at once communicated his decision to his father:

I write from the classic shades of old Yale. The "City of Elms" is at present my stopping place. I left Flushing Wednesday at 2 o'clock P.M. and, thanks to Robert Fulton and the paddles of the splendid steamer "Connecticut," at 9 o'clock P.M. I was set down in New Haven. I soon found my old friend C. Storrs, from whose room in North College I am now writing. I shall probably return to Flushing tomorrow. My session of 5 months is closed. We have no regular vacation, but the departure of many of the students at this the regular time of departure leaves us without a very pressing amount of business, and so I have taken a short respite. My present idea is to return to Flushing and remain two months, until Dec. 6th, and then take up my residence in New Haven. I have visited the Analytical Laboratory which is hardly a stone's cast from my pen's point, have seen and conversed with Prof. J. P. Norton. . . . He is a fine specimen of a polished, real live Yankee (I should judge), very plain, unpretending, and possesses a "quantum sufficit" of common sense. The encouragements he holds out to me are of the most flattering kind. The success of his enterprise, the "Chemical School," is beyond that of the Cambridge establishment, and since expenses of living are so much cheaper here than there I am decided that this is the place. In answer to my inquiries concerning the support a chemist could command, he said that there were two situations to one man already, that he had applications now that he could not fill and had been

obliged to send away young men to fill places before he wished to; that is, before they had fully completed their course. He thinks there is no risk in getting lucrative employment, especially as Professors and Teachers of *Agricultural Chemistry*. My expenses here would be about \$350 or \$400. And here let me say a few words as to the funds I have at disposal. The wages for my winter's work were \$80. for my summer's \$150. = \$230. Where is it? Oh where is it? where? ———? I have given about \$20. in obedience to the golden rule, to whom I may not say. I believe it was well given. My journey home cost about \$10. My return cost me nothing. A watch cost \$12. I have procured clothes to the amt. of \$15., \$30 or more has gone for books,—*all good serviceable necessary books*. My present expedition consumes with the utmost economy—shilling dinners at restaurants, \$10. A dozen excursions to New York, etc., have cost as many dollars. Sightseeing, all laudable for I don't give money without getting its worth, has taken more. I have improved my leisure hours with chemical study and experiments—this has used money—and I have only about \$100. left. Two months more will swell the amount to \$150. This will keep me in Yale 6 mo., then I can look out for ways and means to raise more. My bodily appetites I can control, so that I have only one passion that is a well ridden hobby horse that consumes money *without* control, and that is a love of books, or what is in them. When I get to Flushing I shall expect a letter from home and a *Northern Journal*.—

This “Chemical School” of Professor J. P. Norton at Yale was the immediate outgrowth of the private laboratory of Professor B. Silliman, Jr., who, previous to his appointment in 1846 as “University Professor of Chemistry and the Kindred Sciences as Applied to the Arts” in Yale College, had received private pupils in chemistry—among them John Pitkin Norton. At

the opening of the college year of 1847-48, Yale College gave recognition to the movement for scientific education by appointing a committee of the corporation to take into consideration the establishment of a "Department of Philosophy and the Arts," which should continue under official sanction opportunities for extra-curriculum study heretofore afforded only as the personal undertaking of certain professors.* Prominent with Professor B. Silliman, Jr., in this movement was Professor John Pitkin Norton; and their "School of Applied Chemistry," or "Analytical Laboratory," as it was familiarly called to distinguish it from the "Chemical Laboratory" of the elder Professor Silliman, was opened in 1847 in the old "President's House" on the College Campus, becoming a part of the new Department of Philosophy and the Arts. It began as a technical school of chemistry, it has developed into the Sheffield Scientific School, whose undergraduate courses have in late years so rapidly increased in number. Its status at that time

* In the autumn of 1847 the catalogue of Yale College stated under the heading, "Department of Philosophy and the Arts":—"Professor Silliman, Jr., will instruct in Elementary and Analytical Chemistry, Mineralogy and Metallurgy. Professor Norton will instruct in the applications of science to Agriculture and in Analytical Chemistry." Under the subheading, "School of Applied Chemistry," it continued:—"Professors Silliman and Norton have opened a Laboratory on the College grounds, in connection with their departments, for the purpose of practical instruction in the application of science to the arts and agriculture. Every facility will be afforded to those who desire to obtain special instruction in general and analytical Chemistry and in Mineralogy. A course of lectures on the connections of science with agriculture, by Professor Norton, will commence in January and continue about two months, at the rate of about four lectures in each week. Professor Silliman, Jr., will deliver during the summer a course of lectures upon some other department of applied Chemistry."

is well described in a memoir of Professor B. Silliman, Jr., written by Professor Arthur W. Wright: "Although the School had been thus formally recognized and had attained to an established position, it received little other encouragement and no substantial aid from the college. . . . The cost of fitting up and equipping the Laboratory, and of providing apparatus, cabinets and library, was furnished from the private means of the two professors, who received no salaries from the college and even for two years paid a rent for the use of the building."

In 1849, B. Silliman, Jr., became professor of medical chemistry and toxicology in the Medical School of the University of Louisville. During the five years he retained this position he spent each winter there, thus leaving Norton alone in the duties and responsibilities of the Analytical Laboratory for a part of each college year. Professor Norton was a forceful and untiring worker, of marked ability as a writer and lecturer, who gave much time to the cause of scientific agricultural education, speaking before agricultural societies, and writing constantly upon scientific topics for the better agricultural journals. He was a practical agriculturist as well as a trained scholar, who saw his duty to lie in work for the country at large quite as much as within the walls of the laboratory where he was training others who should later succeed him.

In January 1850, Mr. Johnson went to New Haven, relying for support upon his modest savings. This year was an eventful one for him. The classes were small and he was thrown in close personal contact with Professor Norton, whose stimulating and broad-

ening influence hastened his intellectual expansion. By the end of the year he had definitely decided that he would follow Professor Norton's advice and go to Germany for further study, especially under Liebig, who had been the first to offer laboratory instruction in chemistry and who ranked at that time as the greatest master of agricultural chemistry in the world. How to carry this plan into effect was a serious question. Mr. Johnson's father would have helped him most willingly to an education in the law or in medicine, but was not inclined to aid in the way he wished. The subject was debated from both sides in the family letters. On July 10, 1850, Mr. Johnson wrote:

Dear Pa and Sarah,—The 4th brought me Pa's answer to my first two letters and last night the letter containing the \$20.00 safe—I was not particularly shocked at the thought I could not prosecute my studies next Autumn and Winter, although I had set my heart upon it. Even if I could do no more for 6 mo. or a yr. at chem.—if I had better engage in earning means—still I regret losing the opportunity of getting a balance with so little trouble and \$30.00 cheaper than I can after this term. Prof. Silliman jr. will not be here for at least a year and a half after he leaves in Oct. He spends the winter in Louisville and in the spring he visits Europe, with his Father. The balance costs \$60., the freight etc., about \$10.—\$20. according to circumstances. If I could send soon it would probably not cost more than \$68. as it would be freighted with other articles. With a Balance on hand next spring I could work to advantage at home, after doing something next fall and next winter to raise "the rocks"—if somebody would chuck \$75. in my pocket next Oct. I would order. But! "'tis as 'tis and can't be much 'tisser." My last chance must slide—let it go easy.—As ever, very *sonily*, Samuel.

The advocacy of his sister Sarah and opportunities during the summer vacation to talk the matter over face to face, led to a modification of Mr. Abner A. Johnson's views. In October, Samuel, as indicated in the following letter, was in receipt of an allowance from his father and was again at work in the Yale Analytical Laboratory.

(S. W. J. to A. A. J.)

—'Tis in vain! What eloquence can fitly introduce the subject? How can I make it pleasant. I resign myself to Fate and Destiny. *I write for money!* What! the boy! He had enough he said. He promised to economize. Why does he want more?—Softly—Earth is trial ground, none are secure from misfortune. On my return here my India Rubbers were gone, couldn't be found, none knew of them. I left them in my room. They were doubtless carried off by mistake, (\$1.50). I thought to let the matter rest, and shed no tears for the scows wherein I was wont to navigate the wet and slush of New Haven Winter. But this was not all. I labored industriously at my business. Poor unfortunate! A vessel whose thickness could not be measured broke from the weight of its contents. A cascade of corrosive acid went over my breeches and boots, they were saved, the boots perished. *My new boots, my only.* They have now "no music in their sole" and the uppers have "give out." (To replace them here \$4.00 or less.) My room which I engaged last term was very comfortable and small. A friend from Flushing Inst., a nice young man—Ezequiel Uricoechea of Bogota, New Granada, S. A.—at my instance enters this department one week hence. An opportunity presented for exchanging my room for one that would hold us both, furnished with a nice new carpet worth \$16.00, my half \$8.00. My old rent was \$24.00, my present ($\frac{1}{2}$ the whole) \$12 $\frac{1}{2}$ —I thus save 11.00 rent and pay 8.00 for carpet—\$3.00 is thus saved

from one yrs. expenses. I had to supply a stove and a lamp, I now supply but 1/2, \$5.00 more gain at least for 1 yr. The exchange gives me a carpet and \$8.00. I have not hesitated to make the exchange, although a little money is required now instead of by and by. I am owing E. U. \$7.14. I need a pair of boots. My old cap will last until I go to Wallingford, then I ought to have a new one. No! I shall need none. I can't afford to visit next vacation, it will do. What has become of the \$50.00? I have the list of expenses, it is long or I could transcribe it. Only one or two items I regret, live and learn. I have a few dollars left,—\$4.00. I hear *not* Prof. Silliman's lectures, they cost \$12.50. I take an instructor in German, it costs \$5.00. I buy no candy except cough candy, and I rejoice to have no occasion for it. I do the best I can, considering my frailties. I strive to overcome them. I guess \$10.00 will keep me the rest of the term—

After replying to the preceding appeal, his father wrote:

Deer River, 27th Novr. 1850.

Dear Samuel,—Yours dated 28th Ult. was received asking for \$10. I wrote and enclosed \$15.—that you might get a cap and visit cousin Gilbert at Wallingford next vacation—but have received no answer as yet, whether you received the letter or not. You either have not received it, or have forgotten the charge given you to acknowledge the receipt of money as soon as may be after the receipt of it. I write now to learn whether or not the above has been received. I directed the letter to S. W. Johnson, Chemical Department, Yale College, New Haven.

Write the time and amount you need to pay up for this term. I think you calculate \$125. That amount is in readiness when needed, will buy a draft as before. You are daily remembered by

Your affectionate father.

The problem of ways and means for European study was constantly in Mr. Johnson's thoughts. On December 16, 1850, he asks the family's advice:

Dear Father,—Immediately upon the reception of your last (that I have received) letter (Nov. 27th), I wrote home acknowledging the former rec'ept of \$15., and stating that I should probably want \$130. more. Sarah's letter has been receiv'd and shall be answered soon. I shall be an assistant here next term, and thus my expenses will be diminished \$200. per annum. Prof. Norton thinks the best thing I can do for my mastery of the Science and for my future success, is to go to Europe next summer and study there two years. He says the expense will be \$1500. How to get the money I know only one way, and that is to borrow it as Prof. Horsford did, getting a life-insurance policy as security in event of death. If some of my rich friends would lend me the money, giving me 5 yrs. to pay it in, I would take the responsibility of the debt. I should be more than \$1500 worth better [*able*] to fill such a station as I look to, and could as a consequence command a better situation. A fellow student, son of a wealthy Hartford Gentleman, with whom I have been on the best of terms since I came here, will go to Europe next summer if I will. I wish the opinion of the folks. I shall rejoice if Heaven makes my path across the great waters to the great European shrines of science, and if I must stay,—'tis His will who doeth all things well. Praying that God may strengthen me in a new life of obedience to Him and bring us all an unbroken family around His throne,—I subscribe myself, your affectionate son,

Samuel.

In May he wrote in a similar strain, saying:

College is "in full tide of successful operation." I am busily occupied in the Laboratory and with the study of German. I attend Prof. Thacher's class, 4 days in the week.

He continued:

—I had an invitation from my friend Mr. Bunce of Hartford (who stays at home this summer but intends to return to the Lab. next term) to visit him last vacation. His father was anxious to make my acquaintance as I am to be his son's companion in Europe! Am I, or am I not? \$2000 separates me from Europe besides 3000 miles. I can borrow any quantity of money at the savings bank here, at 6 pr. ct. interest, on the strength of three responsible endorsers. I can secure, by a life insurance for \$2000, costing about \$30 per annum, my endorsers in case of death, but can I get anybody to endorse while I am expected to live? If some of my rich friends want to invest money, here is a chance. I am more and more convinced that a European education is necessary to put me in the front rank where I want to serve. I don't fear but that I can pay the debt in two or three years after my return, if health and strength are permitted. I have no doubt that, with such an education in my profession as I shall then possess, I may do my share of duty in life, and assist in bringing up to honorable and useful womanhood the sisters who may before many years be consigned—parentless—to their brothers' care. May Heaven long delay the time of their orphanage!—

In June, Mr. Johnson suddenly postponed all preparations for going abroad, owing to a most unexpected opportunity for earning what was at that day a handsome salary. Concerning this, he wrote:

Dear Father,—This letter has a SECRET which it will be best not to tell anyone of except mother.

Prof. Norton has had offered him, in addition to other employment at Albany, the Professorship of Chemistry and Natural Philosophy in the State Normal School. He does not wish to accept, and intends recommending me to the post, and says he has no doubt I may obtain it. The work is 5 hours a day, commences in Sept, 5 days per week during the

two terms of 20 weeks or thereabouts. The pay is \$800. (eight hundred dollars) somethin'! Now I may receive a letter from them requesting me to come up there and give them a sight of me, and I may be aaccepted and may not. Since I may not, it is best that nobody know it. If I receive the appointment there, it may be told of. Now if I go to Albany I shall want my wardrobe replenished somewhat. I shall be obliged to give up, in part, my economical student habits, and walk in the first rank of society!—and I shall want some money, and if I can make a good impression it will be almost the last time, I hope, I shall trouble my very kind and good Father for money. I shall consequently relinquish for the present the idea of going to Europe, and if I obtain the situation shall give myself to its duties. My expenses for the term will be for board, rent and washing about \$45. To Albany including outfit, and I have scarcely anything fit to wear on such an occasion—I shall have to buy a hat—a Panama is most durable, I think \$2.50, coat 4 or 5, pants 3 or 4, shoes 3.00, hdkfs. etc., call the outfit \$15. I hardly dare undertake the journey with less than \$10., though in my student way of doing things \$5 would be amply sufficient. Then at the close of term I must go home. I may have to stop at Albany for some business or other there, so here goes for \$15. Thus it stands—

Term expenses due 27th of July,	\$45.00
Outfit and money to Albany— <i>wanted soon</i>	25.00
Money home—wanted 27th July,	15.00
	<hr/>
	\$85.00

I hope not to be obliged to use all this, but want enough in every contingency. If I should not get the situation it would be rather bad, but the prospect is so fair I had better try for it, had I not? If I should get the situation I would not exchange it for any place in the country—for—*The University of Albany* is going into operation next winter, and will in time

gather more or less permanently there the best scientific men of our country. Agassiz, Norton, Hall, Mitchell, Gibbs, Whitney, Guyot, Pearce, etc. What a place! If I succeed I will tell more. My love to all. Affectionately, Samuel W. Johnson.

A few days later he wrote from Albany:

Dear Folks,—No secret! I have just returned from lobbying about the State officials and am “Professor of Chemistry, Nat. Philosophy and the Principles of Agriculture” elect in the State Normal School. I have not accepted the situation, and delay to do so until I hear from home, as I had not rec’d an answer to my former letter when I left N. H. yesterday at 1 o’clock. I have been introduced to Prof. Perkins and the Normal School Corps, to Hon. Christopher Morgan, Sec’y of State, Dr. T. T. Beck, Dr. Campbell, Mr. Hawley and another gentleman who (the last five) form the Executive Com. of the Normal School. I have also visited Mr. Tucker of the *Cultivator*. Had an introduction through Hon. S. H. Johnson, to A. B. Street the Poet. Seen Hon. C. Lyon, etc. S. H. J. is staying at the “Stannix” where I now write. He is much worn by the extra session of Legislature. They adjourn tonight probably. I return to New York tonight and N. H. tomorrow. My salary is \$800. and I have a \$12. check for my expenses hither and back to N. H. Write at the earliest mail as the Committee are anxious to know my decision. In haste, Affectionately, S. W. Johnson.

His plans for the summer were given in the next letter:

Yale, July 12th, 1851.

Dear Father,—I have just returned from Albany and found Pa’s letter of the 5th in the box of P. O. next to mine, where it has been for nearly a week I have no doubt. There was a change of boxes the 1st of July which may account for

this delay. It contains \$90. safe. You have before this rec'd my letter dated at Albany, containing the news of my election to the situation at the Normal School.

I must now work hard until the close of the term to finish some investigations which I wish to present to the "Am. Association for the Advancement of Science" at its next meeting at Albany, August 18th, 1851. I may be accompanied by one or two young scientific friends when I go home, who intend to visit the mineral localities North. They will not stay long at Deer River. Affectionately, Samuel.

Study and commercial analytical work had kept Mr. Johnson's time well filled during the eighteen months spent in New Haven. His only publications in this period were one scientific paper upon the discovery of sulphuret of nickel in Northern New York and an educational article, setting forth a plan for a "County Agricultural Institute" designed to undertake work similar to that now done by the State Experiment Stations. This latter was published in the *Albany Cultivator*, which, established in 1833 as the organ of the New York State Agricultural Society, at this date was owned and edited by Luther Tucker, who had brought the old journal up to a high standard of literary excellence, Eben N. Horsford, John Pitkin Norton and Donald G. Mitchell being among its contributors.

Mr. Johnson passed the school year of 1851-52 in Albany, teaching natural sciences in the New York State Normal School. Here, as always when he had mature and earnest pupils, he was an inspiring teacher, and won friendship and admiration for himself through his teaching. No home letters covering these months are in existence. It is not far from

Albany to Deer River, probably visits were frequent and letters few. We know that he made friends, enjoyed the broader opportunities of cultured society which his position opened to him, and did good work in the classroom.

Professor Norton's courses of lectures on the connection of science with agriculture, delivered at New Haven and at Albany in the winter of 1851-52, attracted attention, following as they did so closely upon the publication of his book, "Elements of Scientific Agriculture," which, as the "Prize Essay" of the New York Agricultural Society, had made his name familiar to a large constituency; and the School of Applied Chemistry at Yale had through his efforts attained to such a position that announcement was made that "Students who enter this department may hereafter have in view a degree to be given when they have completed a certain course of study." His broad conception of professional obligation to the cause of scientific education led Norton also to join with earnestness in the movement for the establishment at Albany under State patronage of a university in which agriculture and its connected sciences should have a prominent place. This double duty—for he kept up his work at New Haven, traveling twice a week between the two cities, and lecturing three times, in each—proved too much for his strength. After a vain trip south in search of health, he died in October 1852, at his father's house at Farmington, Connecticut. The sudden ending of his life brought sadness to the colleagues and pupils who loved him, and proved a heavy blow to the two struggling institutions for the success of which he had been energetically working.

Although he died at the early age of thirty, he had exerted so strong an influence that his work continued after him in the lives and labors of those who were called to take up the duties which he laid down.

In letters written to Mr. Johnson in January and in May 1852, Mr. William J. Craw, then assistant in applied chemistry in the Yale Analytical Laboratory, gave the following account of the laboratory and their mutual friends there:

If the sorrow of your friends can be a pleasure to you, you can have that pleasure in the assurance that you have been very much missed in the Laboratory. . . . There are quite a number of *regulars* in the Lab. already, and we expect a considerable force of volunteers from the Senior class; and Prof. Norton lectures. . . . I presume you heard all about the degree of Bachelor of Philosophy which is to be given next summer, but lest you hear not, I will say a few words on the subject. The requirements are—to be connected two years with the College, and to pass satisfactory examinations on the three branches of which French or German must be one. There will be quite a number of the “old Lab.” candidates, and if you should decide to be one of us, need I say that you will be met with a hearty welcome? . . . The Laboratory is getting along pretty well, though the number of students is small at present. We expect an accession of six or eight from the Senior class in two or three weeks, or as soon as they have finished their examination. Prof. Norton has not yet returned from the south, though he is expected to come very soon. . . . Brush is now here in New Haven, studying up in preparation for examination at commencement, as he intends to join the “Bachelor of Philosophy” class this year. Brewer is coming on the 1st of July and will probably join it also. So you see that we are likely to have quite a strong force and a good jolly set of fellows in the bargain. I wish *you* could be with

us also at that time. But I suppose your aspiring spirit will be satisfied with nothing less than the Ph. D. from some German University.—

Profitable as the experience gained during this winter in Albany was, Mr. Johnson regarded it only as an inevitable delay in his real work in life. In the autumn of 1852 he returned to the Yale Analytical Laboratory to finish his preparation for foreign study. He cooked his food in his room, embraced every opportunity to earn or save money towards his European expenses, and studied hard to acquire a knowledge of the German language, which he realized was essential to future success in his profession. Two letters to his father, written in January and in March 1853, give a vivid description of his occupations and ambitions at this time:

I am full of business, so much so that I can hardly find time to write letters.—I always, however, find time to write when I want money, which is the case just now. Instead of hiring a furnished room which I had thought of doing, I furnished one at an outlay of nearly \$20. for bed and other furniture, and consequently have that sum less than I should otherwise have had for present use. I board myself at about \$1.50 per week. Wood and light cost high, wood \$8.00 per cord and some cold weather now uses it up fast. I shall make ends meet in the spring, but shall be saved much trouble if Pa will forward me \$10. which I will repay when I am able. Prof. Porter has given me opportunity to make analyses for him for which he remits me 2 months' laboratory charges. . . . Yours of a week or two since came to hand enclosing X dollars. It was all very acceptable, although I was in no pressing need. I have long had by heart the lesson that it is hard for a poor fellow like me to acquire an expensive educa-

tion, and although the sky is often dark with disappointments, no matter, I am used to it. I must go to Europe before I can think of engaging in any business, if it be possible. What I shall do the next summer, I don't know. Notwithstanding my greatly improved health, I am not in working mood more than half the time. But the object I have steadily pursued for 8 years can't be yielded now, I am bound to put it through. Being obliged to look out for funds, I am distracted and hindered in my studies so that I have not accomplished half so much this winter as I might have done had I "the rocks," but there's a good time coming, I believe, and I am going on to meet it.—

CHAPTER II

LIFE AND STUDY IN EUROPE

For five years the father had been quietly watching and testing his son. Very soon after receiving the letter just quoted he decided to give him an amount equal in value to the farm already given to each older brother on the attainment of his majority. With this to rely on, Mr. Johnson started at once for Germany. He went first to Leipsic where he worked in Erdmann's laboratory at pure chemistry, studied German, made acquaintances and friends, and gradually gained a sympathetic insight into German family and social life. The diary, kept from the time he left New York until he arrived at Munich the following year, and family letters furnish a picture of his student life abroad. His last letter before sailing in May 1853, is addressed to his sister Sarah. In it he mentions having sent to her husband his "3d of Exchange" and describes the delays attending the ship's departure:

—The Good Ship New World with all her cargo, crew and passengers lies at anchor now in New York Bay, just inside Sandy Hook. We left Peck Slip, foot of Beekman Street, at 1 o'clock P.M. We were towed out by a steamboat to our present anchorage, about 18 miles from N. Y. city. We have a fair wind tonight, but the crew is *too drunk* to warrant proceeding, by morning, however, the liquor will all be gone and we then expect to get under weigh for England if the wind is favorable. The night is calm and starry, the old ship

lies almost motionless, and we expect a good night's rest. When we shall get another, I can't say. I am tired enough to do else than write, but improve the last opportunity to send by the pilot a letter home to the friends I've left behind. There are twelve cabin passengers. The Captain's wife is aboard. There are 40 sailors and hands and 50 2d cabin and steerage passengers. Mr. J. T. Norton identified me at the Metropolitan Bank. I procured a Bill of Exchange for 50 Pounds sterling of Brown Brothers and Co., 59 Wall Street, for which I paid \$243.89, the rest of my funds is in Am. Gold, by advice of Mr. Brown. I procured a Passport at the Custom House. I enclosed to J. C. E. my 3d of Exchange, reserving 2 copies for myself. Pa will please take charge of it. It needs no endorsement, as Mr. Brown told me. I left my trunk at Taylor's Hotel, containing my daguerreotype which is somewhat damaged, and "Memorials of Prof. J. P. Norton," given me by his Father.—*Wednesday A.M.*—Fine clear morning. We are getting under weigh, and have every prospect of getting outside the Hook in an hour or so. The sailors make a lot of music, and of a rather pleasing character.

Among Mr. Johnson's fellow passengers were Professor Noah Porter, afterward President of Yale University, Mrs. Porter and Mr. E. Norton of Farmington, Connecticut, a brother of Professor J. P. Norton. Mr. Mason C. Weld, who had been a student of scientific agriculture under Professor Norton from 1848 to 1853, accompanied Mr. Johnson from New York and was his roommate during the whole of his stay in Germany.

Mr. Johnson wrote from Liverpool on June 1:

—We arrived here Monday May 30th, later than we anticipated on account of losing our wind. Yesterday the whole party of the New World's cabin, except one, went together to St. James' Park, and witnessed part of a cricket match.

In the eve. we went to the Zoological Gardens and saw animals, pantomimes and fireworks. Today we all go to Chester to visit the celebrated antiquities there. Thence Weld and I go to London tomorrow, the rest of the Party go elsewhere. We are in excellent health and spirits. Weld and I are stopping at the Waterloo House, a fine English hotel, and we do justice to all the comforts, eating and sleeping with a vengeance. I have written so much for the *Northern Journal* that I may be excused for doing so little in this. If I had plenty of money, Merry England would keep me for a few weeks, but one gets pretty well bled here, and we can't stay. Goodbye till a week or two, when I get in Germany I will give my address so that letters will reach me.—Don't complain because I have not written about every thing!—

(From a diary)

Thursday June 2d, 1853. Took 2d class train for London. Stopped an hour in Crewe—got breakfast in a cottage. Arrived at London at 7 o'clock. Drove to Sam's coffee house, 302 Strand.

Friday June 3d. Walked out in morning to St. James' Palace, Green Park, Hyde Park, etc. Called on Dr. Darby, thence went to museum of Economic Geology. Saw Mr. Price who gave us letters to Dr. Hoffman. Looked over their cabinets and went home. Called at Mr. Way's laboratory, found Mr. Ogsten, Way being on the cont. Had a chat and went home.

Sat. Went to Royal College of Chem. Dr. Hoffman turned us over to Mr. Morley who showed us through the rooms. Went to Way's as stated by mistake in paragraph above. Called again on Dr. Darby, left sugar. Visited Zoological Gardens and thus finished the day.

Sunday June 5. Went to Westminster Abbey and heard service.

Monday June 6. Called at the American Legation, saw

Mr. Ingersoll and Mr. Cram, had passports viséd, went to Lee's and left directions for binding. Visited British Museum. Went to 302 Strand and napped while Weld went to St. Paul's. Got dinner, and went to Cavendish Square to attend meeting of Chemical Soc. Met Price there.

Tuesday June 7. In morning visited Tower. Saw the Armory and Jewel Room. Walked through the Thames Tunnel. Crossed London Bridge to the Station of the S. E. R. R. Dined, spent afternoon in Hyde Park, Kensington Gardens, etc. Had a look at and into St. Paul's.

Wednesday June 8. Exchanged money. Settled accounts. Wrote home. Squared up all around and left London at 6 P.M. by S. E. R. R. for Dover, with through tickets 2d class for Cöln. Arrived at Dover at 9 P.M. Looked about a little, embarked at 11 P.M. for Ostend on a Belgian Steamer. Spent the night miserable in her cabin.

Thursday June 9. Arrived at Ostend very early and in a fog. Had no difficulty with the Custom House, got breakfast and a commissaire, got rid of "viel geld." Took an early train to Ghent. Riding to Ghent found that 2d class tickets were not available thence to Cöln. Were obliged to purchase 3d class tickets in addition, and then were allowed to take 1st class cars and go ahead. Had sufficient to admire in the scenery of some parts of the route (vide Murray). Had passports viséd at Aachen. Arrived in Cöln in good time, got baggage through the Customs and drove to the Germanischen Hof—found an English-talking landlord and got good accommodations.

Friday June 10. In morning took a look with a commissaire around and through the famous old city of Cologne. At 11 A.M. left by R. R. with tickets for Paderborn (vide Murray for remembrances of route). Arrived at Paderborn in fair time to book for Warburg by Schnellpost. Drove to the White Swan—had supper and a jolly good time, and at near midnight drove off in a diligence.

Saturday June 11. Snoozing and waking arrived at Warburg in the early morning. Took R. R. for Cassel, meeting a Conducteur who spoke English, a jolly good fellow who took us to the "König von Preussen," got us diligence tickets etc. to Göttingen, whither we posted at 10 o'clock after looking a little at Cassel. Arrived at Göttingen at 4 o'clock. Found the "Krone" and High Worthy Herr Rettman, who toasted on champagne and got off "true pain to sham friends"—took us around to the fellows' rooms. Found none but Williams at the Gardener's House. Coming into town found Weyman and Uricoechea, had a jolly good time until bedtime.

Sunday June 12. Went to Reformed Kirche and in P.M. to gardens.

Monday June 13. Hospiteered on Dr. Waltershausen. Saw Hof. Woehler and the Laboratory.

Tuesday. Hospiteered on Hofrath Woehler. Rode out to the Plesse in the afternoon.

Wednesday June 15. Made our partings and left for Cassel at 4 P.M. whither we arrived in good season, got supper and left by a night train, the first of the season, for Halle.

Thursday June 16. Morning found us in Halle. Went to the Kron Prinz, got breakfast and sallied out to find Mr. Young,—in two hours of search by the final aid of a German student found his room, and in 3/4 of an hour found him. He took us to see a German friend of his who gave us letters to Menzel of Leipzig. Called on Chapman, thence went to Station, and were soon on the way to Leipsic, where we arrived at noon, stopping at the "Hotel de Bavière." After dinner sallied out and called on Dr. Erdmann, found him and his Lab. open and right. Himself talking some English and jolly. Found Menzel and with his aid after two trials found a nice cheap room with apparently a nice Wirth and Wirthinn. Returned to the Bavière and lodged.

Friday June 17. In morning got over to our lodgings, adjusted accounts to some extent, entered the Laboratory and got agoing on Ultramarine, bought Will's Outlines, 2d ed.

Saturday June 18. Heard Dr. Erdmann's lecture. Worked in Lab. 3 hours of morning. Dined at "Hotel Garni Kaiser Oesterreich." In P.M. called on Hof. Morgenstern and were fairly received, but must call again with testimonials. Called at Hugershoff's establishment.

Sunday. Walked in Rosenthal.

Monday 20th. Attended Dr. Erdmann's Vorlesungen, and went with him and Weld to Hofrath Morgenstern, where Weld presented Uncle Ben's Empfehlungsbrief and the Hofrath talked like it. Returned to Lab., finished Ultramarine. Visited Hugershoff and made a few purchases.

Tuesday 21. Worked in Lab. on an etwas seltener Substanz. Purchased hardware, etc.

Wednesday. Continued work and developed the Hauptsache of Pechblende, Uranoxyd. Found besides Lead; Bismuth, Iron, Alumina, Lime, Magnesia, Silica. Ordered Lamp from Hugershoff's.

Thursday. Things as usual. Prof. gave me an organic salt, which I soon found to be pierate of potash. Then came a mixture of Propylic, Butyric and Valerianic Acids, or some of them. Concluded from behavior of silver salts that it is mostly Propylic in combination with Soda. Bought a fine umbrella at 4 Th. Weld and I walked over to the Polizei and were allowed to come "Morgen." Letter to Uriecoechea.

Friday—June 21. St. Johannis Day. Went to Laboratory and found it shut. Returned, ordering Löwig, and Lehmann's Phys. Chem. The former was sent me. Found Butyric and Valerianic acids well treated of. Propylic briefly. Made improved blowpipe tongs, after Weld's suggestion, all but platina points. Received permission of residence from the police. Walked out into the Johannis Thal, the "Gottes Acker's" etc.

Saturday June 25. Worked in Lab. the forenoon. Made some progress on the Chamomile Acids. It is quite certain the Butyric acid is in pretty large quantity. In afternoon went to Brockhaus Buchhandlung. Purchased Liebig's Org. Analysis, Schawz's Maasanalyse and Weber's tables. Ordered Liebig and Kopp's Jahresbericht for 1850 and 1851. Our Wirth brought us Will's Analysis and Erdmann's Lehrbuch. In afternoon had a call from Menzel.

Monday June 27. Worked in Lab! Prec. mixed acids by AgONO_5 for at. wt. detr. Called on Dr. Zenker and took first lesson in German.

Tuesday. Wrote home. Worked in Lab. Gave Prof. etwas Zucker. Undertook atomic wt. estimation. Blundered all day hunting crucibles, (Royal Porcelain depository was not open) drying and weighing, finally got it nearly finished.

Wednesday June 29. Finished At. Wts. of Valerianate of Silver. Rec'd letter from Uricoechea. Went out to the Military parade. Bought bathtub.

Thursday June 30. Analyzed a substance used by the Chinese to procure Kindtodt, found only Fe_2O_3 and SO_3 and HO , but no WO_3 , no TiO_2 as a Belgian chemist had reported. In evening went to concert in Rosenthal. Ordered Huger-shoff's best balance, got new Spirit Lamp.

Friday July 1. Rather unsuccessful in preparing xl Malate of Lead from crude Malate of Lime. Dr. Erdmann's Lecture on Pt. Pd. Os. Ir. was very interesting. Spirit Lamp and Iodine distinguished Pd. from Pt.

Saturday July 2. Dr. Erdmann lectured on Gold. Mentioned the gilding of the cut section of a platina gilt coin. Was unsuccessful in getting xls of Malate of Lead from the evap. sol. of yesterday. Cleaned platina ware. Procured Alkalimeters of Huger-shoff. Weld and I adjudicated our accounts.

Sunday. Went to Nikolai Kirche in the morning. Walked about town in P.M. Birthday.

Monday. Found lead salt of Malic Acid crystallized, but in small quantity. Undertook preparation of Acid Malate of Lime, morning will tell how successful. *Great Fire.* Visited Am. Consul. Weld rec'd weekly *Post* of June 16.

Tuesday July 5. Found fine xls of $\text{CaO} \cdot 2\bar{\text{M}}$ at Laboratory. Our Wirth has at last finished our book binding.

Wednesday 6. Unsuccessful attempts to procure more xls of $\text{CaO} \cdot \bar{\text{M}}$. Fire in Great Windmill Street near by Dr. Zenker's. Could not get to the Dr. for the military that guarded the streets. Got our inscription at last, for 6 Th. 25 sgr. 4 pf. Went to Theater in eve. to see Hamlet done in Deutsche. "Es stinkt zum Himmel." Got a cheap place for 20 sgr., which in the morning we might have bought for half the money.

Right Hand of the Rector!

Thursday July 7. Obtained our Pocket cards in morning. Was desperate sleepy in Dr. Erdmann's Lecture. Must sit near the window tomorrow. Still worked at Malate of Lime. One week at Malate of Lead. Es Muss! Dr. Erdmann's story of the bees as big as bears with hives of usual size. But how can the bees get into hives, smaller than the bees themselves? "Na, sie *Müssen* hinein!" The Malate of Lead muss!

Friday. At Malate of Lime etc. Treated Malate of Lead after Dr. Erdmann's directions. No xls. Prepared newly acid malate of Lime. Evap. the old stock of malate of lead pre. by SO_3 and HS.

Sunday 10. Nikolai Kirehe.

Thursday 14. Took tea at Dr. Zenker's. Had jolly social time with Herr Dr., Frau Doctorinn und Fraulein Marezoll.

Friday 15. Dr. Erdmann opened to Weld about Berzelius, Liebig, Gerhardt. Commenced on Butylic Alcohol.

Saturday 16. Attended Neumann's Lecture on Snow and Rain. Was visited in evening by König.

Wednesday. Fusel oil.

Week ending July 30. In Lab. worked at Fusel oil. Friday our balance was done—cost 69 Rthl. Saturday Graf Weld and I took a walk to Napoleon's Denkmal. Ate at Stötteritz and had a good time.

Sunday.—Wir gingen morgen zum Catholisches Kirche und nachmittag zum Schützen-Haus, das Sommerfest zu sehen. Da begegnen wir Herr Ebermeyer mit ein Deutschen Freund, Mr. Costello und ein Franzoser mit eine Englische Damen. Wir sprechen viel Deutsch und den heiligen Tag zerbrechen.

Thursday 4. Things grow old if they do not progress. Heard music in Neu Markt.

Friday 5 Aug. Lab. as usual, and there gouged two fingers. Attended Sommer Theater. Found letter from home, on return to room, dated July 17, mailed 18, left New York 23d July—13 days from New York.

(A. A. J. to S. W. J.)

Dear Son,— . . . —It is quite natural that you, in a strange land divided by 3000 miles of Ocean from your native land should think of it and home with deep interest. At least I hope so, and believe you do and will continue to, but as you have gone there for improvement you will, I am quite sure, use your time to advantage. As you speak of the hours they were all employed, and you borrowed time to write. Have relaxation enough to ensure health of body and mind, for what will knowledge avail without them? You and Mr. Weld must watch over each other for good, as I trust you will, both for time and Eternity. The manners and customs of the people differ widely from ours; and yet there is much good there to be copied, no doubt, and evil to be avoided, which I have confidence to believe you will do wisely. You have not said whether you are among Papists or Protestants.

While it is necessary that you economize well, I don't want you to suffer loss in improvement by being too much stinted

in necessary means,—I suppose you will not want anything more from me before next winter. As I told you before leaving home, you must let me know long enough beforehand so that I can raise the means without having to make sacrifices to get the money; and also the manner of transmitting it to you, or your obtaining it by draft on some house in New York or elsewhere. I want to get along to supply you without involving myself or property, if possible. Easton will want help, Esther wants a piano, etc., etc., but your ease stands first on the lists. My heart is larger than my treasury. I want to make all things meet right. I abhor to be in debt. I should be unhappy if my pecuniary concerns were deranged. I want when I leave the stewardship to leave it uninvolved, if possible.

May the Lord bless you.—

(From a diary)

Tuesday 9. With Weld walked to Gohlis, and read upon an arched gateway “Here lived Schiller and wrote the hymn to Joy in the year 1785,” and in the upper story of a little, funny house the poet lived, over the window of which was a sign “Schiller Stube.” I carried home and pressed among other flowers 3 sprigs of a Lubiate from near the gateway.

Monday August 15. No more lectures from Erdmann.

Friday 19. Call from Hiller who brings report from the American colony at Göttingen, walked about town with him and had a revel in Auerbaeh’s Keller.

Thursday 7—Saturday 17. Studied Schiller.

Saturday 17. Weld returned from Thuringia 4 A.M. At about 10 we moved to our new lodging 1678 West Street.

Week from 17 to 25. Discontinued lessons from Dr. Zenker. Remarked the opening and progress of the Fair. Rec’d letter from Father with *Independent*. Several *Tribunes* arrived. I purchased two Agate mortars for 16 Rthl. Translated something in “Holland Dairy and Cattle.”

(S. W. J. to A. A. J.)

Leipsic, Sept. 23, 1853.

Dear Father and friends at home,— . . . —I have staid in Leipsic the whole of the vacation since the 20th of July, and shall probably remain here through it, *i.e.* till Oct. 20. Mr. Weld made a journey of two weeks with knapsack on back through the Thuringian Provinces lying west and slightly south from Leipsic. I would have accompanied him, but wanted to study German, and concluded to remain here. . . . I was greatly rejoiced to hear that Mother had been able to make so much of a journey as the one to visit Uncle Charles. I wish she was over here, I would like to “tote” her down to Lombardy to spend the winter where the climate is not precisely like that of Deer River. As to newspapers, Weld and I now take the *Tribune* for Europe weekly, it costs 5 dollars per annum including postage. I have received a copy of *Northern Journal* of Aug. 31 containing some R. R. talk and the *Independent*. The *Independent* though marked *paid* was not marked *franco* which is the only *paid* understood here, and cost me 3 groschen, 7 1/2 cents. The *Northern Journal* cost me 20 cents, being so covered up in wrapper as to pass for a letter. The German postoffice is a puzzle, so all the Americans here concur in saying. I spend usually a half hour daily in a reading room in the city where, besides one U. S. paper “The Satanic Press” the infamous *H*——, I find the London *Times*, *Punch*, and several other English journals besides hosts of German papers. With regard to the Cavenish Society, the subscription is \$6.00, more or less, annually according to the number of volumes printed. The New York agent is H. Bailliere. He is paid for the current year and I have the receipt.

I have money enough to last till March, and more too, unless unforeseen expenses arise. My estimate of necessary living expenses for the winter—for 6 months—is as follows and is liberal so far as I can judge.

	Rthl.	Out of the 145 Rthl. (Rix Thalers) balance must come
Board	40	books and other conveniences.
Washing	10	In March we intend to go to
Laboratory and Lectures	40	Munich. Prof. Erdmann has
Light and fuel	10	seen Baron Liebig and en-
Rent and lodging . . .	20	gaged places for us in his
Clothes	30	laboratory. Munich is the
Et ceteras	30	cheapest city in Germany,
	—	there the gulden = 42 cents,
Total Rthl.	180	will go as far as the Thaler
Cash on hand	325	= 73 cents in Leipsie, so say
	—	authorities in travel. My bill
Balance	145	of exchange for 50£ obtained

in New York brought me here 333 $1\frac{1}{3}$ Rthl. or about 73 cents per Rthl. The loss is thus about 4 pr. ct. of the actual value. The Rthl. having an actual value of 70 cents. Whether this loss in exchange can be avoided or not I don't know. If I can have a remittance of \$100 in Feb. I will lay out for books, especially as Leipsic is the place for books. If it will not be convenient then or before to remit, I will hold on to my extra 100 Rthl.— . . .

(From a diary)

Thursday Oct. 6. Gillingham called on me at 8 A.M. Walked with him into town, left him to arrange his business, and went to Fritzsche. Found there the 3d volume of Lehmann. Ordered at 25 pr. ct. discount a lot of books. Thence to visit Waring and Coolidge, talked a pleasant hour with them, then found Gillingham and went with him to Dr. Vogel's 1st Burger Schule. Prof. Allen shortly came, and we made a circuit of the school. Examined the Dr.'s maps and Nutz Plans. Saw a class of boys writing to a tune.

Saturday 8. Pleasant day. Wrote in morning, at 3 P.M. called on Messrs. Waring and Coolidge, found Mr. Allen of the Burger Schule da. Ging mit Herrn Waring und Cool-

idge Herr Dr. Zenker zu besuchen, die Herren sich bei ihm zu studiren entschlossen. Bought tickets for the Gewandhaus Concerts.

Thursday 13. Visited Waring and Coolidge. Was called upon at 4 P.M. by Mr. Pugh just arrived from America.

Jason Clark Easton had married Mr. Johnson's sister, Sarah, in 1851. His letters show that Mr. Easton was some time in finding his true vocation in life, trying first one then another occupation, and meeting with a fair share of success in each. It was not until he encountered the problems presented in the settlement of the Northwest that he found his opportunity. There he foresaw the form the development of the country would assume; he became a successful banker and was largely concerned in the construction and management of railroads in Minnesota, in the extension and development of which he took an active part. The affectionate intimacy of boyhood continued until old age, and kept him and Mr. Johnson in close sympathy. The dominant characteristics which shaped the lives of the two men, starting under conditions so nearly identical, are interesting. Widely divergent in their development, each recognized in the other a capacity which he himself did not possess and found hard to understand, while admiring and respecting it. In November 1853, Mr. Easton wrote to his absent brother-in-law, closing with these words:

—As much as I want to see you, I do not want you to come home till you have done all you have intended. I want you to come out a strong man. I am proud of you as a brother and expect to see you one day one of the first scholars in this country. I wish I was rich, I would send you all the funds you wanted. I don't, however, apprehend that you will lack.

If you do, I will help you to stay there six months or a year. So don't be uneasy about money. Write me a few lines often. I will willingly pay the postage. We are all so glad to hear from you that we have a little sort of Jubilee when we get a letter from you.

Mr. Johnson now had the happiness of feeling that his prolonged expenditure of time and money on his studies was fully approved by the two men whose business judgment he most valued, his brother-in-law and his father—who only a few weeks before had reassured him on this point, saying:

While you can improve your state of knowledge stay there, for some time to come. I shall expect to furnish means as you desired, if possible. If I can get along without lessening the fountain, the stream flowing will be larger. I hope to do so, for if the fountain head begins to lessen there may be danger of its becoming dry. I must keep my expenses within my income, but I mean to keep you supplied with the necessary means. You are remembered by all in love.—

In these days, when money can be so easily and cheaply sent abroad, the following letter is worthy of note as showing different conditions sixty years ago and the fortunate relations which enabled Mr. Abner A. Johnson to forward remittances to his son without undue expense:

Deer River, 31 Decr. 1853.

Dear Son,—After waiting with painful anxiety more than two months, yours dated 26th Novr. came to hand. . . . Could you find time to write more letters they would be very gratifying to your friends. As to that you must be the judge. Be sure not to overtax yourself physically or mentally. I hope to live to see you, much improved in body and mind.

Your abstemiousness in meats and drink will be very likely to promote health, if you do not overtax yourself with too close application to studies. . . . Knauth, Nachod and Kühne want 74 1/2 cents for the Prussian thaler, I think it paying rather dear. I have been today to Carthage and let Mr. Stuart have \$210. He will send it to Mr. Le Ray. Mr. Stuart says you will get the money. You will write to Mr. Le Ray de Chaumont, Rue St. Florentine No. 2, Paris, that your father has P. Sommerville Stuart's receipt for \$210. to be sent to him for you. He, Mr. Le Ray, will either pay the amount on your draft or send in some way so that you will get the money, so says Mr. Stuart, very surely, but how much it will cost he does not know. He says money in Europe, as in this country, is merchandise, but so far as he and Mr. Le Ray are concerned, they take nothing more than they pay out. Mr. Stuart seemed very willing to send, he has money to send besides yours, and has nearly every week, and it all has reached its destination. . . . I wish you a happy New Year. God bless you and make you useful. Your Mother is more comfortable. Our love to you. Affectionately,

A. A. Johnson.

James Donatien Le Ray de Chaumont, through his intimacy with Benjamin Franklin, who passed several years in his father's house at Passy, became interested in American affairs, and in 1785 visited this country on a business errand for his father, who had given a substantial part of his large fortune to the cause of American independence. Through the influence of Gouverneur Morris, Mr. Le Ray then made the first of his large purchases of "wild lands" in Northern New York State. His son Vincent, referred to in the preceding letter, was educated in France, and after May 1807, resided on the New York State lands, where his great house at Le Raysville is still standing. In 1853,

Mr. Vincent Le Ray de Chaumont had returned to France and was living in Paris, but he still took lively interest in his American possessions, and was in close communication with his agent, Mr. Stuart, who lived at Carthage, four miles from Deer River. Mr. V. Le Ray employed agents in Europe to procure emigrants for his American lands, on which at this time were fully three thousand French and German settlers. To these he advanced their necessary expenses in taking up the land; he also was in the habit of extending banking courtesies to his New York State neighbors.

On January 24, 1854, Mr. Johnson acknowledged the receipt of this remittance:

Dear Father,—Yours of Dec. 30th came to hand 4 days since, and while I was waiting to get some advice as to how I should request Mr. Le Ray de Chaumont to forward the money, the transmission of which to him Father's letter mentioned, I rec'd a note from him written in French inclosing a "first of 'change" to the amount of 294 16/30 Rthl. on Hammer and Schmidt, bankers of Leipsic. $210 \div 294.5 = 71 \frac{1}{3}$, very considerably less than $74 \frac{1}{2}$, making this an excellent method of transmission. The Bill of Exchange I presented this morning to Hammer and Schmidt, and they are ready to cash it as I want it. I also mailed today a letter (in English) to Mr. Le R. de C., acknowledging the receipt of the draft, and thanking him for his kind offices. I am surprised that such long intervals find place between my letters. I should write oftener but that it seems a pity to pay so much postage on a short letter, and the daily events of my life do not furnish material for very long ones. I shall now try to bring up my arrears to all the people.—I am greatly obliged for the new stock of funds. Having laid in a good stock of books, I have nothing more to do than to keep away from the

bookstores and pay my living expenses. While I feel that it is desirous to be able to lay broad the foundations of future usefulness, I shall strive to make no unnecessary expenditures and hope to live and repay—partly in money, if needful—the long list of debts that I owe my dear and deeply honored Father, whom may Heaven bless in time and Eternity. . . .

The same mail carried letters to his mother and to his little sister, Elizabeth, then aged eleven:

Zwei und Zwanzig Nikolai Str.

Leipzig, Königreich Sachsen,

Januar den 24ten.

Dear Mother,—The above flourish is intended to assure you that your dutiful son is able to write two short lines of German in German style,—an evidence of my progress in literature. What I can write of German life that will interest Mother, I don't know. The mothers of Germany are like those of other parts of the world in many particulars. The German education of ladies usually stops with a full inculcation of the duties and details of housekeeping. Daughters of literary men learn languages, and this is all, save that they all know music and can drink beer, two things which are mysteries to me. They are great lovers of flowers, and every patch of ground and every place where a flowerpot can stand or hang is appropriated. On a fine day the city promenade is covered with nurses drawing children in neat little basketwagons, the little innocents packed warmly between large pillows, two or three of them often together in the same vehicle, enjoying the fresh air. The amount of amusement furnished to children is astonishingly great. There is no end of toys, games, etc., of all possible kinds. The little boy of my landlord has swords, guns, pistols, drums, fifes, violins, wagons, birds, horses, etc. by the bushel, and something new every week. The old people keep up the love of amusement acquired in

infaney or childhood. Concerts, balls, "tea fights" etc., are continually on the carpet. The poor journeyman who earns besides his board and lodging 75 cents a week considers his "Vergnügen," i.e. *Pleasure*, an item of expense as necessary as his clothes. Ladies here not only drink beer and wine, but also punch, or grog as they call it. This however is nothing alarming, no spirit is consumed here that would burn alone and while very many manage to keep jolly a large portion of the time, nobody gets drunk. One of the niceties is *rum in tea*. Coffee is immensely drunk. A German breakfast consists of 2-3 cups of strong coffee, without milk most usually, and two little rolls taken immediately upon getting out of bed. It is foreign and barbarous to eat a meat breakfast. Dinner is a long and formidable affair—coffee is used as a sort of lunch between meals and by many as a winding-up of dinner. A hotel dessert is bread-butter and cheese. Pies are only to be had at the confectioners or coffee houses. Cakes are made in vast variety. Every day now, one meets lots of people in the streets carrying baskets of a kind of cake tasting like butter cracker somewhat, and shaped like ∞. "Pretzels, warm and soft" is the cry, but they are invariably cold and usually hard; they sell at 3 or 4 for a cent. At Christmas a kind of plain fruit cake was in great vogue, called "stolle." Every family baked for itself, if it had conveniences. A big piece, like a thick stiek of stove wood, was presented to Weld and myself from our landlady, and was productive of memories of the further buttery. I intend one of these days to write to the *Cultivator* an account of a market day in Leipsic. The agreeable duties of marketing are mostly confined to the Ladies. The country ma'ams and misses come into town from all directions early in the morning, some in bags, some in rags, some in wagons, and some in leather breeches and sheepskin roundabouts or sacks. Some of the more important ride, but the larger number take their own conveyance. They bring their truck of all sorts, cabbages, earrots, beets, blossoms, black bread, 'taters, turnips and all imaginable kinds

of greens in baskets upon their backs. They take their station in the street or in the market place, and sit all day long, rain or shine, freeze or thaw, and sell their commodities—gossip—drink coffee—if cold, warm their fingers over little pots of charcoal—and when night comes, travel 1 to 5 or 10 miles back to their houses. I bought one day a bushel of apples of a market woman, and she brought them to our room. It was cold, and of course we had a fire. The old lady labored up two pair of stairs without minding it, and setting down her burden exclaimed, “Oh, it is warm here, it is not warm at home!” We have had but a few cold days. But they were hard for the poor, fuel here is very dear and many suffered when the cold was most intense. . . . Leipsic is a well governed city. There is very little suffering compared with that found in many German towns. But Mother, the paper is so near full that I have space only to wish you a happy New Year—a year of renewed health and strength. Most affectionately, My dear Mother, Your, Samuel.

Dear Sister Elizabeth,—The letters you have so kindly written me have given me great pleasure, and with no lack of pleasure I now attempt to answer. I shall tell you a story of Christmas time in Leipsic, and all about the pretty custom here of making little folks happy about these days. Many good people here believe that Christ was born on the 25th day of December, and nobody knows to the contrary—and since the gifts of “peace on earth and good will to men,” of redemption and everlasting joy in Heaven which he gave to his children by coming on the Earth to die for them, were brought on Christmas evening, the good people of Germany make their children pleasant gifts on this night, to make them happy and remind them of the Savior who has given them the great gifts. My good friend Dr. Zenker called on me the 23d of Dec. to invite me to his family Christmas festival to be held the next day. I went at the appointed time, and found 4 other Americans, all acquaintances, invited to join in the

festivities. Several other young people were present and, besides the Dr's 4 children, a little boy and girl from a neighboring family. On entering the house we heard the voices of the children in one of the parlors where they were staying, impatient for the signal that should announce that the tree was ready and summon them to receive the Christmas presents. After waiting some time the door of the Dr.'s study was opened, the children were led in, and we followed. On one table were the gifts for the Dr. On another were arranged as many plates as were guests invited, and on or near them were cakes, nuts, candies, etc. On a sofa and floor were arranged presents for the children, and in a corner stood the Christmas tree, a pine branch 5 or 6 ft. high, set upright on a wooden pedestal, having little candles made of various colored material burning at the end of the twigs, and hung with ribbons, colored paper and a host of nuts, raisins, little cakes, etc. Each one now was conducted to his portion of good things, and we began shortly to look at each other's presents and amuse ourselves in conversation, which you may be assured did not slip my tongue quite so easily as it would have done could I have spoken in English. Dr. Zenker received many nice gifts from his good wife, new curtains to his study windows, a huge piece of "stolle" or fruit cake as big as a very thick stick of stove wood, a box of cigars,—for every *he* German smokes,—a fine medallion of Goethe the great Poet, given by an American, and cakes, candies etc. The children of course had the fine things. One had a kitchen with dishes, stove, hams hanging on the wall and all the fixings complete, another had a chamber with furniture, dolls, etc. The little boy received a riding horse, a gun, a flute. I found on my place a teacup and saucer made in Leipsic and having a picture of the city upon it. Tea cakes, sausages, herrings, and other simple refreshments were at times distributed. We talked lots of German, were all vastly happy, and at 10 o'clock bid the Dr. and Doctorinn good night. They wished us "to sleep well," and "to come and see them right quickly again,"

and I have not been there since. I could write lots more but the paper is nearly used up—so goodbye— Samuel.

Baron Liebig, who had left Giessen, was preparing to reopen his laboratory in Munich, and there was some uncertainty as to when it would be in running order. Through correspondence with Munich friends, Mr. Johnson learned that the expectation was that the building would be finished by May, and that the semesters would correspond to the regular university semester—the lectures commencing on May 2. The rules adopted at Giessen for the conduct of the laboratory would continue in force at Munich. Baron Liebig's response to a formal application from Mr. Johnson and Mr. Weld was as follows:

München 14 Febr. 54.

Ich beehre mich Sie zu unterrichten dass ich mit meiner Übersiedelung nach München den praktischen Cursus welchen ich in Giessen hielt aufgegeben habe und keine Schüler um sie zu unterrichten mehr annehme. Ich habe übrigens das hiesige Laboratorium so eingerichtet dass einige geübte junge Chemiker, die Sinn und die Hülfsmittel für eigene Arbeiten bringen können und wenn Sie einige Aufgaben die Sie selbst gewählt mitbringen und hier ausführen wollen so will ich Ihnen einen Platz einräumen ohne weitere Verbindlichkeit für mich ausser für den Fall wo ich Ihnen besondere Aufgaben die mich selbst interresiren übertragen dürfte. . . . Ergebenst der Ihrige,

Dr. Just Liebig.

Herrn Samuel Johnson und Herrn Mason C. Weld. .

(From a diary)

March 22, 1854. Packed up affairs at Leipzig and left at 7 A.M. for Halle with Pugh in company. Found Young in

Halle, with him visited Salt Works (Salinen). Heard the story of the headman, and saw the stages of manufacture, took specimens. Visited Prof. Heintz, found him burning a fatty acid. He showed us pure Palmitic, Stearic, Lauro-Stearic and one other acid, xlied in scales, and remarked on the general law that mixtures of these in certain proportions gave needles of margaric acid, so called. We looked around his small but busy looking Lab. and left most favorably impressed with his kindness and ability. Took leave of Pugh and Young, and 4 P.M. found Jacoby in Magdeburg. With him visited the Dome, a splendid old church. Walked about the city till 6 P.M. and left for Potsdam whither we arrived at 10 P.M. We shortly found the Stadt Wittenberg and took lodgings without further adventure.

March 23. At 2 P.M. left for Berlin. Arrived there, we called at Waring's lodgings, but he was not in. Shortly Prof. Porter overtook us on the street. We settled lodgings at 75 Dorothy Street, then walked about town somewhat, called on Prof. Porter, then took supper at a restaurant and shortly turned in.

March 24. Got out at 8 A.M. and heard Prof. Gustav Rose lecture capitally on Rothgültigerz and Fahlerz.

Then visited Rammelsberg, calling first at his house where we saw his lady, but found him in shirtsleeves at the Gewerbeschule. He received us very cordially and showed us his Laboratory, including the admirable gas arrangements, the pipettes with glass stop coeks, sulphuretted hydrogen apparatus, etc. We promised to hospiteer tomorrow and left. We then called on Chapman after dinner, which I took in simple style in the Thier Garten. We then called on Prof. H. Rose who received us in the most friendly manner and invited us to tea on Monday Eve. At 4 P.M. we surveyed the Freesees on the Museum, then I returned to room and went to Mitseherlich's Auditorium, but there was no lecture.

Saturday 25. In morning heard Prof. H. Rose from 9-11 on vanadium and chromium. Then spent two hours in the

Old Museum. Then went to Café de Bavière and dined with Waring and Burton. Thence we went to Heureuse café and ate Connecticut pie and drank chocolate. Called an hour or so at Waring's room and then went to my inn. Bought a 20 Rthl. suit of clothes and visited the American Minister Gov. Vroom in the evening. There made the acquaintance of several Americans.

After several weeks of travel, Mr. Johnson settled in Munich, where he worked for eleven months under Liebig, von Kobell and von Pettenkofer. He also studied German agriculture. The number of English-speaking students in Munich was small, the common language became a common bond, and the life, comprising many different interests, gave a broader culture than in these latter days of specialization. Mr. Johnson mingled with the musical and artistic set of students, and his increasing mastery of the language permitted familiarity with the riches of German literature, interest in which was stimulated by social intercourse with the family of Professor von Kobell, the chemist and poet. In the first letter sent home after reaching Munich, he said:

I have at last arrived at Munich where I shall probably spend the *2d year* of my European residence. I arrived here in a *snow storm*. The climate of Munich is the worst of all Germany. Lying at a great elevation and near the Tyrolese Alps, it is subject to great and sudden changes of temperature. But I don't believe it beats what I have been accustomed to. A Blackriverite can stand all any thermometer can. There are here Geo. J. Brush of Brooklyn, Geo. W. Weyman of Pittsburgh, Penn., M. C. Weld and S. W. Johnson—all old companions in the Yale Laboratory—and another of our old company, O. D. Rood of New Haven, is on the

Atlantie and will join us in a few weeks. Weld and I have very nice quarters with a very nice family, and in Munieh, a city inferior to none of Europe for its treasures of Art, and with Liebig in Seience, we have the promise of a most pleasant as well as profitable time. Baron Liebig is now out of town, but returns in a few days. I shall probably attend some lectures on mineralogy and other seiencees, but as before I shall be mostly oocupied in the Laboratory. My money has run rather low, but I shall get along very well until July or August, and perhaps later, and then I shall not need a very heavy sum.—

(S. W. J. to A. A. J.)

July 3d. 1854.

Dear Father,— . . . I continue to enjoy excellent health, better than for years,—better than last year. Everything goes on most pleasantly and I am progressing in my studies most satisfactorily. I am glad to hear that some vines of my planting are growing to give pleasant shade and that my old Bireh tree has begun to be evidently alive. . . . Father says, if I visit Paris eall on Mr. Le R. de Chaumont, etc. It is perhaps time that the question of my further movements be diseussed. What I wish to do is one thing, what I can do is another. My mind is now made up to stay here until next April or May. Then I shall have finished 2 yrs. Then I shall go home, of course, if I have not means of staying,—I should be a fool if I didn't. But,—but,—I think I ought to stay one year longer and if I saw the way I would certainly stay 2 yrs. Next spring I shall go to Paris as I can't leave Europe without seeing that city. It happens that the attrae-tions of Paris are as great in seience as in fashion, and there are a dozen great men there with any of whom I should be proud to study. There is also to be a Crystal Palaece, or World Exhibition, opened there next spring and for these reasons, as well as for aequiring a talking use of the French language, I want to stay 6 months in Paris. My edueation would be

very incomplete without it. Again, very likely the best openings for me at home will be in the way of Agriculture. After my 2 1/2 yrs. at Chemistry, I want to spend a 1/2 yr. at Agriculture more exclusively. For this Edinburgh is the place. There is science, and in the vicinity is practice. I want 6 months in England. I won't say anything about how inestimably valuable it would be to me to spend another year in Germany. When I think of Heidelberg, and the great Bunsen; of Berlin, and glorious old Heinrich Rose,—my heart or stomach, something in that neighborhood, aches. I have just got to be able to appreciate and enjoy Germany. I have conquered its tremendous language in so far that it gives me no trouble, and yields me great positive pleasure. Today I am 24 yrs. old, old enough to know more and to be more. My calculation would bring me at 26, another year in Germany 27. That is pretty ancient for a young man. But could I, I would spend my days till 30 yrs. in this glorious old Europe. But I ought perhaps to go home and put a shoulder to the wheels of progress in my young native land—with all her youthful stains vastly more glorious than the monarchies of Europe. What shall I do? Shall I stay 2 yrs. longer, or only 1? Of course I can't very accurately estimate the necessary expenses, but I suppose that \$500. would pay my way in Munich, take me on a visit to Paris, and bring me home about a year from this time. Living in Paris and England is far more expensive than here, and I should probably need \$7-800 to carry me through the 3d year. I need to know before October whether I can stay 1 or 2 yrs. longer, because if I stay 2 yrs. I shall study French here next winter so that I shall get to Paris able to Parlez-vous a little. I am very thankful that the French were not so badly confused at Babel as the Germans were, their language is comparatively small potatoes. Now my *friends* must make up their minds what they can give me. I have no desire to impoverish the good people and shall appear at Deer River in 6 months if so ordered. If the tune is \$500, I shall be home next spring.

As to the money next to be sent, it is all the same to me, 200, 300, 500 dolls., either sum will last till it is gone. 300 is enough for a long time. I can take care of more, but I get no *interest* here, and that may be worth something at home.—

(A. A. J. to S. W. J.)

Deer River, July 28th, 1854.

Dear Son,—I have a desire to live to see you established in some useful station, be that as it may, I hope we shall both so live here that we may live hereafter where there will be no more death, I believe it is our privilege. I also desire to live to see your young sisters come to mature age with a prospect of their usefulness and respectability. You express a desire to stay longer in Glorious Old Europe than the two years. That depends upon circumstances. If I live and can furnish the necessary funds, you can stay. If I should be taken away the means may not be available in time to answer your purposes, as the obligations in my possession run a long time. I should think there might not be much doubt but that you might have funds in some way for the third year. I hope that with the last remittance you will be able to get along till March or April, but you must be furnished, even if you need sooner, tho' the amount set apart to last till the above mentioned time is pretty well used up now.

We have read ten of your letters in the *Country Gentleman*, of considerable length. The editors crack them up pretty well. Love from all, especially your Mother.

(J. C. E. to S. W. J.)

Lowville, June 9, 1854.

Dear Samuel,—Your April letters have been received and read and re-read by all the connections in Deer River and here. . . . I have fixed upon no definite course for the future. I have thought of the western country, but Sarah objects.

If money was the only thing to be thought of, I should not hesitate to decide that as the best course. If I go with a view of making money, I should be obliged to go to some new part of the country where anything like decent society would be out of the question. The pleasantest thing I can think of would be something like the operation you and I once talked of on "Uncle Abner's" flats. What would you suggest as best for us to do? *July 27.* "Uncle Abner" and Esther have just been here and brought your June letter which he has just received. He says he intends to enable you to remain 3 years at least. . . . Rather than have you fail of your plans, I shall, if prospered, assist you some myself, so go ahead, lay out the ground work large for a big edifice and do not trouble your head about the money, for I believe it will be forthcoming.—We can hardly be reconciled to have you stay away so long!—. . . Your friend and Brother, J. C. Easton.

(A. A. J. to S. W. J.)

Deer River, Octr. 4th, 1854.

Dear Son,— . . . Now Samuel, write once a month and I will willingly pay \$1.20 postage, or more, yearly. It seems a great while since you left, now nearly 18 months, and to think of 18 months more that you wish to stay! What changes may take place is known only to Him who knows all. . . .

I forked over \$293. today to A. S. Goodrich the blind man, for a pianoforte. It is put up at J. C. Easton's and Esther is performing on it. The railroad companies have stopped work in these parts. The Utica Co. will complete the road to Booneville before doing anything this side. Money is scarce, they cannot sell their bonds, and all the stockholders have not paid all the calls. I have paid 7 installments of 10 pr. ct. each on \$400.—am glad I took no more stock, \$120 will finish my liabilities and if I lose all, can get along a while. Our love to you.

(S. W. J. to A. A. J.)

Munich, Oct. 5—54.

Dear Father,—I have been so long delaying to write a *good long letter* that now, seeing no immediate prospect of getting ready to do that, I take this slip of paper, determined to fill it and send it off. I gave accounts up to the middle of Aug. and later, I believe, in my last to Jason. I have been all the time in Munich and have been mostly quite well, am now very well. The cholera, after carrying off 3000—3 pr. ct.—of the citizens of Munich, has been officially declared to exist here no longer as an epidemic, and things are getting lively again. I was surprised a week ago by a call from my old friend *James Waring* who hammered through St. Lawrence Co. with me 4 or 5 years ago. He has been travelling through Europe the last 6 months. He staid here 5 days and we did up all the Munich sights, and they are neither few or small. . . . My correspondence with Mr. V. Le Ray de Chaumont has extended to other than money matters. His first letter was French, I answered in English. He wrote me this summer a Yankee letter, inquiring about the navigation of the Danube near here. I had the pleasure of giving him some information he wanted. I commenced yesterday taking instruction in glass-blowing from Mr. Greiner, a celebrated thermometer, etc., maker here. I go again today as soon as I finish this. I can't neglect so good a chance of acquiring some skill in an art so useful to me. The next semester opens in 3 weeks. I shall then do little but attend to Laboratory work. I have been studying Agriculture (German Authors) this vacation and shall do more of the same sort of thing.

I send Mother a new kind of Rose, the *Munich Rose*. They do not grow except in their native city. I can't get a slip, or a young plant. I have only been able to get a blossom. This, although somewhat dry and flavorless, is yet rather pretty and will keep a long time, fully retaining its colors. I send it to Mother since I have no sweetheart or no sweeter

heart to whom to give it. In constant though faint expectation of receiving a letter, I remain as dutiful and affectionate as I was 10 yrs. ago,
Samuel.

Mrs. Abner A. Johnson was a lover of flowers and a skilled cultivator of them, her garden containing many little known varieties.

(S. W. J. to A. A. J.)

Munich, Friday Oct. 27, 1854.

Dear Father,—Today rec'd yours mailed at Deer River the 6 and at New York Oct. 10—My letters to Lowville and Deer River (one each) have probably arrived before this unless, as may be the case, one of them went down in the Arctic, the loss of which has been known,—or reported,—here some week or more but is not mentioned in the latest N. Y. papers which arrived today. I rec'd the money all right in time, though at a rather late time. It occasioned, however, no inconvenience. I was absent from Munich when it came and it was two weeks before I returned, and then I delayed some days in order to get up a decently large letter. Munich has recovered its usual healthfulness. The lectures of Baron Liebig commence next Thursday and the laboratory will be open for work on next Monday.

I wrote some month,—or more or less,—ago to Easton mentioning a plan I had of employing myself when I get home, a plan of opening a school of Ag. Science in connection with Lowville Academy.* I expect shortly to hear from him and the rest of the family on that topic. I wrote a letter some weeks since to Father enclosing a *Munich Rose* to Mother. Has it arrived? If not, I will get another slip. In my letter to Easton I talked of getting home next summer, and so it will probably be best to make it. I could study here in Europe

* Fifty-eight years later, in 1912, a course in Agriculture was added to the curriculum of Lowville Academy.

quite a number of years and then be but a beginner, besides the expense is great. In about 18 months I have spent more than \$900.00, and I am a little frightened to think of what I need, or think I need. I don't want to impoverish my good friends who have done so much for me—those good friends are more particularly *one*, familiarly known at Deer River by the title of Unele Abner. At the same time this is certain, I shall never be a student again, and certainly not in Europe when I once get back to the U. S. It would be a little relief if I had some prospect in view of employment at a safe recompense; then I would borrow some money, but as it is I think I must go home and go to work. I *must*, however, travel somewhat next spring and summer. That is a costly but invaluable way of learning. I must study French desperately the next five months and then, with three languages, I can profit by journeying. I can then take the chief countries of Europe slick and clean. Travel is especially important for me if I go into Agricultural Science and Practice, and there is probably the best chance for me. My expenses this winter will be rather high; that is, it is desirable to acquire a good deal and therefore the cost will be a good deal. I must study French with a private teacher and take lessons a long time, not less than 100. Since I don't live in France, I must buy practice. I calculate that in addition to my present small stock of funds, I shall need \$150.—325 gulden—to get along till the 1st of April, 5 months. This is just \$1.00 daily. Of this my living will cost me 135 fl. or \$54., rather low, leaving \$96. for Laboratory, French, Lectures, Clothes and all other incidental expenses. I say nothing about books, since I have been putting my last remittance pretty well through on that score and feel rather obliged to hold up. Fortunately I do not need to buy many clothes. My present stock is nearly sufficient. This allowance is rather *small*, even for Munich, but I shall try to stick to it. For next spring and summer, for 4 or 5 months travel, sending home my traps and getting home myself, \$600. will be the least

figure. Of this, I shall endeavor to make arrangements to raise a part by correspondence. More of this in future letters. *Nov. 1st.* Tomorrow the Laboratory is again open, and Liebig begins the winter course of lectures.

Nov. 2d. Everything is very dull, dull, very tedious, tedious, except just a few things the folks don't care anything about. I can't philosophize, nor moralize, nor sentimentalize, my head is full of ideas that are only interesting to myself, and I think I will lay aside this sheet and add a few lines to an article I am writing on Potato Disease for the *Country Gentleman*. . . . As to the time and manner of sending more money, I leave that to the judgment of the Good People. Whether a bill on London or on a house here is best, I don't know. If I get a remittance in Jan. or Feb. it will be time enough. If the money can be had, the cheapest way would be to send me say \$400. this winter and then I should be supplied for a good share of the summer, and I could receive the balance in London or Paris. If the figures I make are too high for Father's convenience, why then I *must*, and of course *shall*, regulate my plans and expenses according to what can be furnished. When I get home, if I am so lucky, I shall doubtless be able to return something to the treasury which I now so liberally drain. I have forgotten to say anything about my plans of starting an Ag. School, but in my last I have said enough.—

(A. A. J. to S. W. J.)

Deer River, Decr. 5th, 1854.

Dear Son,—Yours mailed 5th Novr. was received on Tuesday 28th. I wrote to J. C. E. and Sarah that evening to come on Thursday the 30th. and make us a Thanksgiving visit,—and also to read your letter. We are now experiencing the severity of a Black-River snow storm. Our Rail Roads have come to a standstill. It is owing to the want of money in this time of pressure. Money is said to be tight. And yet if a

Farmer has cheese, butter, beef, pork, or any kind of grain or cattle, it will bring the money at a large price. Cheese, 9 cts., butter 21 to 22, wheat \$1.75 to \$2., barley \$1.00, corn 87 cts., rye the same, oats 50 cts., etc. etc. I shall try to collect together \$400. some time next month to send to you. What interest and payments are coming to me will not come before March to April, and may not then, although I shall expect some.

Had you not better look to some professorship in some college or seminary? If you wish to do so, can you not obtain a situation through some of your literary friends, or through Luther Tucker or somebody? You speak of writing to Easton about opening a school of Agri. Science in connection with the Lowville Academy, he has not received it. If such a plan would pay, I should be well pleased with it, if not, it should be let alone. The Munich Rose was received in your October letter, for which your Mother is grateful and we all well pleased. You may have orders for more of the same sort.

I believe you do not wish to impoverish your friends. I am willing to deal out for the benefit of my children as much as I can prudently, when the prospect is for their good rather than their greatness,—though none can be truly great unless they are truly good. You rightly say you shall not any more be a student,—I suppose, in the sense you are now. I suppose you always mean to be a learner. Traveling anywhere is expensive, especially in Europe. If you can get something for correspondence, it will help so much. . . .

Abby and Annah say they want to see you. They send their love. They write afternoons, study Colburn's Arithmetic and Smith's Geography. Should you live to come home again to see them, they will have altered much. May Heaven bless you spiritually and temporally is the prayer of your affectionate parents.

Abby and Annah were twin sisters, eight years old, the youngest of the family.

(J. C. E. to S. W. J.)

Lowville, 8 Dec. 1854.

Dear Bro. S.—Sarah and myself have been enjoying today a visit to Deer River. Your Father has just been reading your letter. I am glad that the time of your return is fixed so near. Not that I am anxious that you should be cut short in the valuable opportunities you have in Germany of study, but am impatient to see you, the time seems so long. I am aware that the advantages you are having in Europe are invaluable in the prosecution of your future plans and will probably make a very great difference in your future success. As you intimate, it is getting time for you to define your position on the great stage of life. It is not wise, considering the shortness of human career, to spend too much time in getting ready to act. We should never cease to be students, yet to be students merely will not do. Our acquirements must be turned to practical account. . . . Wouldn't the situation as State Chemist of Massachusetts be a nicer thing than the Agricultural School you speak of establishing at Lowville? If we were to remain at Lowville, nothing would please me more than to have you here. I do not think unfavorably of such a plan. . . . But government patronage with the fat appropriations Mr. ——— speaks of are just the tools for a man of your cloth to work with. With such a situation you will be "in town." Massachusetts seems to be taking a high stand in Agricultural reform. And I think there is no part of our country more favorable for the prosecution of your designs. . . .

Father Johnson received yours just about Thanksgiving Day. So Uncle Abner sent to Carthage, got two turkies, visited his own hen-roost, and got up a Thanksgiving feast for his children. He wrote to us, but unfortunately I was away from home and did not get the letter until it was too late. Amos and Harriet, Margaret and Silas, being of the children, were there.

I am still engaged in settling up my business and intend to go west—to look—about April. I shall be home ready to see you when you come, which I conclude from what you say will not be later, at least, than August. Should life and health be spared to us till then, I calculate we shall have a joyful meeting. Write when you get this and we will perhaps get it in time for a family gathering about New Year. . . .

“Amos and Harriet, Margaret and Silas” were all valued helpers and sharers in the family life.

(S. W. J. to A. A. J.)

Dear Father,—Aware that it is more important to write often than much, I send a line or so by this week's mail—I continue in good health and am too busy to know any news to send. . . . I acknowledged the receipt of the money in a large letter which appears to have sunk with the ill-fated Aretie. I have since written repeating the acknowledgment and do it now for the 3d time. In my last I talked about plans and wants. I am rapidly getting short of funds, but am in no pressing hurry, although I ought to receive at least a small remittance before long and a considerably larger one by about March, as at that time I must pull up stakes in Germany and move westward with the Star of Empire. I regret to leave Munich so soon, and would so like to stay a year in Paris and a time in England, but it won't do to think of it. In my last, I talked about my plans for traveling. If they are thought too expensive, I give them up. I feel it almost a duty to buy more books, but I can also forego this, and will content myself with visiting Paris a few weeks in the spring, and then go to England, and after a few weeks more go home—I shall then have been two yrs. out. Tell Mr. Storrs I can't possibly find time to fulfill my promise to write for the *Northern Journal*. The short time that remains I must improve most assiduously if only to accomplish what

I have already undertaken. The *Country Gentleman* has published all it has rec'd from me, and I don't know when I can write more. By the way, my article on analysis of soils has been translated for publication here in the Journal of the Bav. Ag. Soc. Mr. Brush and I translated last summer a little book of Prof. von Kobell's on mineralogy. The manuscript has arrived at New Haven and Prof. Silliman has promised to attend to its publication. I must go to Lecture—Dec. 14, 8 A.M.

Feb. 10, 55—Yours of Jan. 5th came to hand two weeks ago. I have delayed answering in order to acknowledge the recp't of the \$420 which came to hand yesterday. It amounted to 2193 francs in Paris and brought me 1003 $2/3$ florins here. The florin accordingly costs me a trifle less than 42 cts. which is very fair. Mr. Le Ray de Chaumont writes "My last despatches bro't me notice that your good father had paid my agent \$420 for you, etc." He makes inquiries as to the prospect of settling Bavarian emigrants on his land, etc. He writes a genuine American letter. I continue to be in capital health, as are all the American Legation in the gay Bavarian capital. Weld, Rood, Furness, Furness, Savage, Blight, Impson, Emerson and Johnson are the Americans, and Muspratt, a radical Englishman, goes with us. All capital steady fellows, and jolly withal. I have been translating a long article of Baron Liebig's, at his request, for publication in the U. S. It is on agricultural chemistry and on the famous Experiments of Lawes and Gilbert of Rothhamsted. I have sent it to Mr. Tucker, but doubt if he will publish it for various reasons. It is very long (57 MS. pages) and rather uses up Mr. Lawes, with whom Mr. Harris, the new assoc. ed. of the *Country Gentleman*, lived a couple of years as assistant. I have directed Mr. Tucker to send it to Sec'y Flint at Boston in case it is not wanted for the *Country Gentleman*, and it will then appear in some other periodical. Mr. William Furness of Philad. is an artist of great promise now studying here. I sat to him for my portrait which he has taken in oil,

and which the fellows say is a good hit. He wishes to send it to his father to look at, and it will get around to Deer River in the course of 6 mos. or less. I shall leave Munich in April probably, I can't say definitely, and may go directly to Paris or possibly stop a few weeks at Hohenheim near Stuttgart in Württemberg to visit the great Agric. School. When at Paris I shall be able to decide on the future. Stephen A. Johnson writes me that he learned from a recent letter of Father's that I have two sisters, one of 16 yrs. and another of 13 yrs., and asks me what I think of their having an English education. He does not say whether he had written to Deer River anything about it. I read that Elizabeth has a lame *limb*, but I don't know whether it is sister Elizabeth or sister-in-law Elizabeth, and further I don't know whether it is a little finger or a *leg* that is lame. In either of these cases I hope that nature may be left to cure it, and the doctors not be called to spoil it. And now, as usual, I don't know what to write about. My life passes in the laboratory, and I can write nothing about it that would interest anybody. I see little society. Occasionally I am invited to dine or spend an evening at Prof. Liebig's, and then have very pleasant chat with his accomplished daughter, now betrothed. (All the young ladies are betrothed with ceremony some 1/2 to 5 yrs. before marriage.) Occasionally I visit the family of Prof. von Kobell, and talk English with his three daughters who speak, besides English and German, French and Italian with great fluency. Besides these two families I have never been in any others in Munich. I write to be remembered affectionately to all the relatives and friends. I hope before another half year to get back home to find them all well and happy. I would write them all long interesting letters, but I can't do it. Spirit and flesh are weak. The evidences of my friendship are to work hard the little time that I have yet to spend here, and not to bother them with my dull letters.—

Answering inquiries made by Mr. Le Ray de Chaumont as to the productiveness of his lands in Croghan, New York, Mr. A. A. Johnson wrote:

Deer River, 20th of March.

Dear Son,— . . . Mr. Le Ray's lands are not generally of very good and strong soil, so far as I am acquainted with them by observation and general reputation. The current of emigration sets to the west where lands are already cleared of timber mostly, and sell at \$1.25 per acre and three or four dollars per acre will fit them for fine crops, therefore his lands cannot compete in market with the western lands, in climate, nor productiveness. A man who can get hold of western land, say 80 or 160 acres, and pay for it and build some kind of a comfortable dwelling place, in a few years will with industry and economy be above board; while the same industry and economy in Croghan will find him struggling for a bare subsistence, he will probably have better health—and that is of great account—but people in their anxiety for this world's goods, don't value their health as highly as they wish they had when they are sick. . . .

We hope to see your portrait by the artist Mr. William Furness of Phila. within 6 months, and the original too—and when we see both will be able, for ourselves at least, to judge if it is a good hit. I have received two letters from Stephen A. and answered both, in his last he wanted my daughter 16 years old (Esther) to come to Manchester, and me to come with her, and leave her there to be educated. I wrote to him that it was not at all likely she would go or I either. If my daughters could have all the advantages this country affords for education, and they rightly improve them, they might be quite as useful as many European ladies. It is your sister Elizabeth that has a lame limb, not a little finger but her left leg. She hobbles about with a cane. When it will get well, time will tell. She is now using a little Massina spring water,

it won't do hurt if it does no good. J. C. Easton and Sarah staid with us last night, he bro't the piano and it is set up in the hall and Esther plays occasionally on it. . . . Our love to you. Affectionately, A. A. Johnson.

(S. W. J. TO J. C. AND S. J. E.)

Heidelberg, Apr. 21, 1855.

Dear Jason,—I left Munich last Wednesday morning and have arrived here on my way home. I enclose to you several letters, all alike, to Am. publishers. By reading one of them you will understand what it is about. I don't expect this thing will take to such a tune as will be satisfactory to the Baron Liebig. . . . I stayed a couple of days at Stuttgart and visited *Hohenheim*, the great Ag. School of Württemberg, and mail today a letter about it to the *Country Gentleman*.—Not to talk about publicly—is the fact that it is slightly probable that I may be appointed chemist to the State Ag. Soc. of New York, also that probably I may have offers to conduct an Extensive Ag. School near Philadelphia,—but of this more hereafter. I shall be either in Paris or in London by the first of May.—Extraordinaries excepted. Love and regards to all who need or deserve.—

Dear Sarah,—I send you this little engraving of Heidelberg, the beautifully situated and romantic old town where in 1386 the first Protestant University in Germany was founded, now one of the most celebrated in the world. Ahem! Bad sentence! Go on! . . . There are quite a number of American students here. Here the great chemist Bunsen has the finest laboratory in the world, not quite done. I wish I could stay and work with him this summer, but this is out of the question. Keep this picture and frame it in the style I recommended for the Munich pictures. . . . Farewell,
S. W. Johnson.

(S. W. J. to A. A. J.)

11 Victoria Park, Manchester, Eng.

May 26, 1855.

Dear Father,—I am at last in England. Arrived here two days ago from Paris where I have been living three weeks. I wrote last from Heidelberg about 4 weeks ago. I went from there down the Rhine to Rotterdam, visited the principal cities of Holland and Belgium in a hurry, and then settled in Paris until coming here. I find Cousin Stephen living in nice and comfortable style in the suburbs of this smoky town. Victoria Park is a delightful place, a perfect English garden. The house looks out in all directions on meadows, gardens and handsome houses. I have not yet looked about enough to know what I shall do. England is the place where I can learn the most in Ag. matters but it will cost an awful sight of money; shillings and crowns here are like kreuzers and gulden in Germany. I believe I had better take the loan of \$500. poor Barnard provided for me and remain here as long as I can, *i.e.* if possible till the middle of Sept. for then the British Association meets at Glasgow. Prof. Liebig will be there and would put me through a little. I also want to attend the meetings of the Royal and Highland Ag. Societies in July.

In Paris I rec'd from Stephen A.	\$ 50.00
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To get home to New York will cost by steamer and I don't choose to go any other way	150.00
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On the channel coming to London the other night I felt how miserable it is to go to sea	
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My boxes etc. etc. getting them to whatever destination I decide upon will cost I don't know how much, but probably not less than fifty—say	50.00
--	-------

\$250.00

I suppose I have but \$400. as Father promised,—there remains \$150. for my stay and travels in England which could scarcely last *one month*. Add to this \$500. and we have \$650. or 130£ with which I can circulate some time.

In my last I wrote about what Mr. Tucker communicated to me on the subject of becoming chemist to the Ag. Soc. of N. Y. *It need not be mentioned out of the family* that I am wanted at Yale College as 1st. assistant in the Laboratory—with a salary of \$700-800 and prospect of shortly rising in *station* and salary. This would of all things please me, for at New Haven I should enjoy the best scientific society that any place in the U. S. furnishes. One and probably two of my friends and fellow students will be Professors there in a few years. We shall see.

May 31. Today I saw Dr. Frankland, Professor of Chemistry in Owen's College here. I shall enter his Laboratory tomorrow and work there a month or more. This will cost 5 guineas. He is very celebrated in gas analysis, and that is what I want to learn.—

(A. A. J. to S. W. J.)

Deer River, July 4th, 1855.

Dear Samuel,—Yours dated June 15th. came to hand on the 30th., acknowledging the receipt of £50, \$247.50, for which acknowledgment so promptly made I thank you, and hope when you receive another draft you will as promptly do the same. I went to Lowville yesterday and purchased a draft on some bank in New York for \$500., for half of one per ct. premium. I hope you will be able when you receive the \$500 to get along comfortably with it, but if you find you want some more, write me in time. I speak of more money only in case you require more to carry out your plans for future usefulness—and feel that you suffer loss for the want of necessary funds to complete your plans.

I remembered, as did your mother, yesterday as the 25th anniversary of your birthday. Today the 4th, the roar of distant cannon and the prancing of horses and rattling of buggy wheels ushered in the anniversary of American Independence the 79th. While I write, Abby is at the piano playing and singing "Mary at the Savior's tomb." Annah can do the same, Esther Amelia is improving quite well, only wants practice and some further instruction to be able to give lessons to others. Elizabeth, poor lame girl, is taking lessons from Esther and makes some proficiency. Gilbert and Elizabeth took a homemade dinner today with father and mother, and the twins, and hired man and girl,—had our first dish of green peas, planted 26th April. Abby and Annah send their love to Brother Samuel, would be glad to see him, as would all of us. I hope you may next fall return in safety, and find a good situation. Be useful and happy in time, blessed in eternity, is the prayer of your parents and friends. Our love to Stephen A. and wife, would write to him could I find anything to interest him. I am not capable of writing other than business letters, and poor at that. Affectionately,

A. A. Johnson.

(S. W. J. TO A. A. J.)

Carlisle, England,
July 25th, 1855.

Dear Father,— . . . Instead of writing anything about the Show here on this greasy paper, I will mail this week two or three papers containing an account of the performances, and leave the folks to read the *Country Gentleman* for what little I scribble about it. I am stopping at a nice Temperance House and pay \$1.25 pr. night for lodging. Many people are paying twice that money, and I was charged that at the place I first applied. I shall probably go from here to Edinburgh, thence to London and to the Ag. College of Cirencester, and sail in 3 or 4 weeks.

Father will have gathered from my letter by the last steamer that I want no more money sent across the Atlantic. I think that, unless for the sake of some of my friends who have so liberally supported me abroad, I shall not avail myself of the funds left by Barnard. That matter can at any rate be left 'till I get home.—

CHAPTER III

NEW YORK STATE AGRICULTURAL SOCIETY: THE "UNIVERSITY OF ALBANY": YALE SCIENTIFIC SCHOOL

In January 1853, Mr. Tucker of the *Albany Cultivator* published the first number of the *Country Gentleman*, which soon became the leading agricultural journal. It exerted a progressive force as an active advocate of scientific education and in its pages are to be found full accounts of efforts to establish the "University of Albany," whose promoters hoped to attract to Albany leaders in every branch of science in this country—as well as many from Europe—and to found a great university which should include schools of pure and applied science, of agriculture and of the mechanic arts, as well as the ordinary departments of graduate study. These plans were urged towards fulfilment in the columns of the *Country Gentleman*, and Mr. Tucker, treasurer of the New York State Agricultural Society and personally active in work for scientific agriculture, did much in other ways to disseminate a sound knowledge of agricultural science. Mr. Johnson's name is signed to an article in the third number of the *Country Gentleman* and appears afterwards with frequency, the last time being just forty years from the date of his first contribution in 1847 to the *Cultivator*. During the winter and spring of 1853, a series of articles from his pen appeared in the *Country Gentleman* under the general

title, "What is Science?" As soon as he was fairly settled in Germany he began to send back across the water accounts of the scientific agriculture of Saxony, and also translations from the French of Ville and the German of Wolff.

In the ninth number of the *Country Gentleman* is printed "Superphosphate of Lime," dated from New Haven, February 1853. In this article, which is reprinted as an appendix to this volume, Mr. Johnson discussed the value of certain commercial fertilizers as shown by the results of his analyses of several samples procured in the open market and analyzed by him solely to show the public utility of such work. The controversy aroused by these analyses is described in a letter from his father, October 1853:

I suppose you do not receive the *Country Gentleman* or *Cultivator*? If you do, you will see that Mr. M——'s wrath is stirred against you by your analyses of his superphosphate of lime. He has got Prof. E—— to make an analysis to prove yours to be false. The editor of the *Country Gentleman* talked to Mr. M——, (for disputing you, I suppose). Mr. M—— continued to rake you over the coals until Professor Porter of Yale came out upon him and said he knew that Mr. Johnson's analyses were correct. There has been considerable ink shed on paper on the subject. Mr. Tucker said Mr. Johnson was a modest young man, as worthy of the title of Professor, and more so, than some who wear it. I would like you should read what has been written since you left dear "Amerika" about you.

Mr. Tucker, at whose instance largely, the New York State Agricultural Society had established a laboratory for chemical analysis, came to the defense of his absent correspondent, predicting as a result

of his "thorough devotion to this branch of science and his sound and discriminating sense, a brilliant career of usefulness to his countrymen." Mr. Tucker wrote in April 1854:

I presume, from your not alluding to it, that you have neither seen nor heard of the controversy which grew out of the publication of your analyses of M———'s and D———'s superphosphate of lime. I shall send you all the papers, if I can find them, in relation to it. You will see that M———, instead of publishing your letter as I supposed he would with his thanks for the credit you gave his superphosphate, chose to assail your motives in making it, and made an effort to prove it all erroneous. I do not think, however, that your reputation has suffered at all from his attacks.

I am very greatly obliged to you for your letters and shall be grateful for any more sheets with which you may favor me, both of letters and translations; and I deeply regret that the income from my paper will not warrant me in offering you such compensation as you deserve. The publication of your letters will serve to make you known and will, I trust, in this way be of some benefit to you; besides this, I shall try to make you some reward for them hereafter.

(L. T. to S. W. J.)

Albany, March 6, 1855.

Dear Sir,—Your favor with the copy of Prof. Liebig's work came to hand on the 2d. inst. . . . —on reading it, I came to the conclusion that the better way would be to issue it in a pamphlet. . . . This method of publication I trust will meet the approbation of Prof. Liebig and yourself. I shall secure the copy-right for your benefit, and place the profits, should there be any, to your credit. I do not know, of course, what the demand will be for it, but I hope it will be such as to yield you \$50 or so.

After the receipt of your plan for an Ag. School, in Nov. I wrote you on the subject, but my letter must have failed to reach you, as you call my attention to it in your present letter. Without going into the detail of what I then said, I will state the conclusion at which I arrived, which was that your acquirements were too valuable to be expended in building up what could hardly fail to prove a mere local institution, and that I hoped a way might be opened in which you could be more satisfactorily employed, both to yourself and the public. . . .

My plan is to have you employed as Ag. Chemist to the State or the State Ag. Soc., and this I am growing more and more confident can be effected by another winter; and it might be done now had we a laboratory where you could work. A law has been passed for rebuilding the old State Hall, which will be done the ensuing summer. The rooms for the State Society are to be greatly enlarged, and, as I understand it, a laboratory is to be fitted up for their use. Here it strikes me is the proper place for you, and here I hope ere long to see you permanently established, with a comfortable salary, and with nothing to prevent you from devoting your talents and acquirements to the advancement of the science of agriculture. I should be glad to hear from you on this subject and have your views as to how you could in such a situation best advantage the farming interest of the State. This plan, for the reason I have named, cannot be carried into effect until another year. In the meantime, the Academy at Ovid would be glad to get you to take the place of Mr. Brewer, who leaves them in May to go to Europe. . . . Efforts are being made to unite with this Academy, Mr. Delafield's Ag. College; and if they succeed in this, you are just the man they would want permanently. . . .

Neither my desire to promote the true science of agriculture, nor my appreciation of your merits, will permit me to lose sight of any opportunity by which I think the joint inter-

ests of both may be advanced. Rest assured, therefore, that I shall be prepared to serve you as efficiently as possible whenever the proper occasion arrives, believing as I do that I can thus aid the progress of agriculture. Very truly yours,
Luther Tucker.

While resident in Munich, Mr. Johnson discussed some subjects of permanent interest in the columns of the *Country Gentleman*. In February 1854, he brought to the attention of his readers the then newly established agricultural experiment station at Moeckern, saying:

The great utility of such establishments, and the hope that the organization of similar ones in the United States may be encouraged by an account of this, induces me to annex a translation of the important features of the statute relating thereto, and approved by the Saxon government about a year since. . . . What agriculture most needs is the *establishment of its doctrines*,—not the proposition of fancies, or of facts which hold good for this or that township, but the evolution of a general theory, applicable everywhere. . . . The basis of doctrine will not rapidly unfold itself. It must be unfolded. If agriculturists would know, they must inquire. The knowledge they need belongs not to revelation, but to science; and it must be sought for as the philosopher seeks other scientific truth. When farmers contribute to the carrying on of investigations having for an object the discovery of the laws of culture and vegetable growth, and conducted by minds that bring to their task that requisite vigor, skill and knowledge, then light will flood in where now is only obscurity. When Ag. Societies make Experiment Stations their care and pride, they will more fully and legitimately approach the accomplishment of their end, the perfection of agriculture.

While appeals to Legislatures have been made in vain for the endowment of agricultural schools—while the means of

agricultural instruction are comparatively nothing, and of accurate experimental investigation absolutely wanting, it remains to private or corporate enterprise to open the way; and this is no unsafe adventure; but, with no need of extravagant outlay, will bring an ample return. The active minds of Europe are united in their expressions of admiration and astonishment at American progress, but here the means of genuine advancement in agricultural knowledge are vastly superior to our own. How long shall this be?

In May, he defined the limitations of soil analysis, and refuted the popular error that an application which should restore to a field all lacking elements of fertility could be successfully prescribed by means of deductions drawn from the results of chemical analysis of the soil in question:

The continued recommendation of soil analyses, as a guide to the farmer, makes it proper to discuss at length their practical value. As a means of developing the natural laws of growth and cultivation, chemical analysis must continue to be, as it has been, of the very highest importance. A few years ago, in the infancy of agricultural science, it was found in many cases, that analysis indicated correctly what improvements were needed by soils; . . . The accumulation of knowledge on these topics has, however, clearly shown that, although it is often true that the analysis of a soil economically indicates the amendments that are needful to make it productive, it is frequently the case that an analysis fails altogether to furnish useful indications; and if its results are valuable, it is often the case that they cost more than they are worth, or at least, knowledge equally good, perhaps better, might have been far more cheaply and certainly obtained. . . . *Soil analysis, at the best, is a chance game; and where one wins, a hundred may lose.* A soil-analysis is always interesting, often valuable, rarely economical. It may amuse the amateur,

and instruct the philosopher, but for the farmer its value is small, if he has to pay for it. It is only by the application of the general principles which may be developed from numerous analyses, that he can hope to be directly benefited.

But what shall the farmer do? Shall he grope in the dark? No! But let him beware of false lights which are now-a-days hanging out in abundance. Let him beware of taking advice from two dangerous characters,—the conceited farmer who knows a little science, and the officious philosopher who knows a little farming.—

In October, he wrote on the practical value of the analysis of plants:

The natural history, the chemistry, in short the whole science of each agricultural plant, must be made the subject of careful investigation. The knowledge of the general conditions of vegetable growth has arrived at a pretty high state of culture. We must henceforth seek to learn those special conditions which determine the utmost development of individual species. Science and Practice, the laboratory and the farm, have this business to perform together. Every plant can be put into such circumstances as will make it tell what it needs for its successful growth. . . .

I trust that in this and a preceding article, I have written nothing to discourage Agricultural Education, or destroy the farmer's confidence in science. If any one promulgates false doctrine in the name of science, he will be found out in time. Truth remains and has a permanent value, no matter who defends or opposes it. My object has been to define the limits within which chemical analysis cannot be practically applied. I desire to give chemistry all the credit it deserves, and have too much regard for that beautiful science to bring upon it future contempt by loading it with present adulation.

In a letter written from Stuttgart, April 1855, published as "Foreign Correspondence," Mr. Johnson

described the Academy of Agriculture and Forest Culture at Little Hohenheim, at that time almost unknown in America :

The pupils are mostly from wealthy families. A finer set of young men I have not seen elsewhere in Europe. They are described as full of zeal in the prosecution of their studies, and when contemplating their animated and intelligent countenances, I could but hope that the day will shortly come when the United States shall also engage her intelligent sons in similar preparation for similar duties. Most of the graduates of this Academy are afterwards occupied with the management of great estates. . . . My stay in Hohenheim was rendered peculiarly agreeable by the kind attentions of Prof. Wolff, whose acquaintance I had made in Moeckern, near Leipsic. Hohenheim has never had until now a man among its faculty who has united eminent scientific ability with practical knowledge. It has been fortunate for the Academy that practice has hitherto held there such dominant sway. It is equally fortunate for it that it now has a teacher who is able to show that practice and science harmonize in most points, and who labors not so much to immortalize himself by propounding and defending ingenious theories, as to advance practical agriculture by attempting the solution of the problems that are encountered in daily life.

Prof. Wolff has had fitted up a spacious though simple Laboratory in which he instructs a goodly number of the pupils in chemical analysis. He finds that when the course is rightly conducted, it proves highly interesting, as it cannot fail to be highly profitable for the pupils. It is in the Laboratory, and from the teachings of the capable agricultural chemist that agriculture is to make rapid advances in its doctrines and literature, while from practical instruction, the existing good systems are to be brought into general application. Hohenheim has hitherto been efficient in diffusing agricultural knowledge; hereafter it cannot fail to become

as eminent for discovering new truths, which shall make itself progressive as it now makes Württemberg and the surrounding countries so. . . .

Hohenheim is doubtless the best school of agriculture that exists, and the agriculturists of the United States, who are founding agricultural colleges, etc., will do well to send out a few young men to take the course here, as part preparation for stations as teachers at home.

During the latter months of Mr. Johnson's residence in Leipsic, a warm friendship, based upon the similarity of their aims, sprang up between himself and his fellow student, Mr. Pugh. Evan Pugh, at the age of nineteen, was a blacksmith's apprentice. He bought the residue of his time, supported himself and studied for a year; then, having fallen heir to a small estate in Oxford, Pennsylvania, which included the rather unusual adjunct of an academy, he taught this school for two years. In 1853 he sold his school which had prospered under his management, and went abroad for study. When Mr. Johnson left Leipsic for Munich in May 1854, a correspondence on scientific matters began between Mr. Pugh and himself which was only terminated by the death of Mr. Pugh. The letters of Mr. Johnson were unfortunately destroyed, but Mr. Pugh's earliest letters, written from Leipsic in 1855, contain his response to Mr. Johnson's proposal that they together should establish in America an agricultural school:

In reply to your questions with regard to Am. Agricultural School.— . . . I sympathize, to the fullest extent with the spirit of the enterprise you propose. . . . With respect to your distribution of the studies and the length of the term, you are in advance of my plans. . . . To sum up: I enter

with heart and hand into the spirit of your proposal excepting that I would rather delay at least one year (to Sept. 1857). . . . Of the success of the institution I have no doubt if it once gets started on the basis you propose.

In the summer of 1855, Mr. Johnson went to England, where he studied methods of gas analysis under Frankland, and also traveled and observed English agriculture. Letters from America kept him informed of the movement of affairs in New Haven. As the result of plans formulated between the years 1853 and 1855 for the development and organization of the hitherto loosely connected elements of the Department of Philosophy and the Arts of Yale College, the students in the Analytical Laboratory and the classes in Engineering were associated together in 1854 under the name "Yale Scientific School," and at a meeting of the Yale Corporation on July 24, 1855, the nomination of George Jarvis Brush* as professor of Metal-

* Professor Brush's life work, the development and guidance to an assured position of the Sheffield Scientific School, is known wherever the name of the school is known. The seemingly accidental way in which he became a man of science is interesting. Professor Brush's father, Mr. Jarvis Brush of Brooklyn, was a successful merchant who, when he found that the indoor life of a business man was likely to impair the health of his son, sent him to the Cream Hill Agricultural School to study scientific farming under an old friend, Dr. S. W. Gold. Through the interest taken by Dr. Gold and his son, Mr. T. S. Gold, in the teaching of Professor J. P. Norton at the "School of Science" in New Haven, George Jarvis Brush went to New Haven and was a member of the first class to receive the degree of Ph.B. from Yale. Mr. Brush's marked business and executive talent, as well as his scientific ability, was early recognized. He became director of the Sheffield Scientific School in 1872, and remained its official head until his resignation in 1898. His success in a task which the temper of the time made one of peculiar difficulty and delicacy was conspicuous. His business capacity and sound

lurgy was confirmed, and Samuel William Johnson was appointed, not as he had hoped and as the faculty had recommended, assistant professor, but merely first assistant in the Analytical Laboratory.

Mr. Brush, who was then in Freiberg, wrote on May 13, to Mr. Johnson :

Silliman says we have \$250 income from the Sheffield fund and \$300 from the Labt. itself, and as Barnard has left \$20,000 the income of which will be devoted to charitable and educational purposes, Silliman is in hope of getting \$250 or \$300 per annum in case *you* should take the place of Asst. at Yale, making in all quite a decent salary to commence on. . . . S. says "no effort of mine will be wanting to that end." . . . Dana adds "I have no idea that the school will ever flourish until there is some one in it who has so much zeal for science that he cannot help but work in it, in researches of one kind or another." . . . So you see, Sam, that we have the confidence of the Profs., and I trust we shall be able to make things move when we return home. We'll see whether we cannot revive things and inspire some new life in the School.

(B. S. JR. TO S. W. J.)

July 2, 1855.

My dear Sir,—I have the pleasure to inform you that you have been nominated *Assistant Professor of Chemistry in the Yale Scientific School* and as soon as your appointment has been confirmed by the Corporation, which will be on the 26 of July, you will have official notice of it. We have for the present decided to offer you as salary six hundred dollars pr.

judgment contributed largely to the result; but the fact that he was a trained man of science, holding an honored place in his profession, enabled him to wield an influence and to accomplish what would have been impossible to one who lacked this important qualification.

annum; as an officer of the College you will, I suppose, be entitled to a room in the College buildings if you wish to use it, and you can eke out your salary, should you wish to do so, by private instruction in the schools.

Your name appears in the July No. of the Journal as Assistant, which liberty I hope you will pardon. Prof. Porter and myself are responsible for your salary, but \$200 or \$250 will be the income of a permanent fund, the remainder if not earned by the Laboratory will be made up by us. We are sorry to be obliged to offer you so inconsiderable a sum, but as you know the Laboratory is unendowed, and we are forced to make it pay its own expenses, *i.e.* salaries of yourself and Mr. Chas. Porter and the material and apparatus, fuel and servant, etc. For ourselves we do not expect to draw a dime from it, and shall consider ourselves fortunate if we do not have to make up a considerable deficit. With the new organization, however, we hope for a new vitality in the condition of the Laboratory. The new system of instruction in the Senior Class by which recitations are substituted for lectures in the proportion of 24 of the former to 36 of the latter will, when it comes into full play the ensuing winter, develop all the chemical talent that there is in the class, and no doubt induce some to enter the Analytical Laboratory who otherwise would not do so. Mr. Chas. Porter, who is the second in authority, yourself being first, will take the commercial analyses and aid you in such things as you may desire. During the first term I shall have 3 exercises daily with the general class, and can, of course, devote no time to instruction in the Analytical Laboratory. But in the 2d and 3d terms I shall undertake to give instruction in mineralogy and in technical chemistry. Until Brush comes home in the fall of '56 we shall hardly be able to make our scheme complete, and shall hold ourselves open for a remodeling. . . . The old laboratory is in a good deal of a dilapidated condition and needs repairs very much. These we shall hope to make in vacation.—Yours truly,

B. Silliman, Jr.

Professor Brush, on August 17, expressed his pleasure at Mr. Johnson's appointment:

Your note of the 4th was recd. a few days since. I am glad to hear that you are so pleased with the idea of going to Yale. . . . Things will go on swimmingly when you take command of the old Lab. . . . You will have hard work, but I am sure you will enjoy it. Don't injure your health by overwork. When we all get back and start our team in good earnest I think we'll be able to do "some pumpkins," if not more. Liebig is rejoiced to hear that you have an appointment, Rood says he was so tickled that he came all the way in the Labt. on purpose to tell him of it. . . . But you, my dear boy, will, I hope, be so situated that you'll have plenty of time for pure science. You have a splendid field before you. Scientific Agriculture is your Liebling, and you are bound to stand No. 1 in your profession. . . .

In August 1855, Mr. Johnson returned to America and to the Yale Scientific School. He superintended the laboratory, gave instruction, collected fees, paid the expenses, and, when needful, tended stoves, washed apparatus and swept up the floor. On October 11, he wrote to his mother:

I should have written before, but I am unaccountably busy. The Laboratory has been in a sadly run-down condition and I have hardly got it to rights again as yet. News I have none. . . . I am well and happy, *i.e.* busy.

On November 18, he expressed his disapproval of the conditions under which he had taken charge of the laboratory in a letter to Professor Brush. The letter is not in existence, but the tenor of his remarks may be inferred from comments in the reply:

(G. J. B. to S. W. J.)

I am very sorry to hear that you find yourself so unpleasantly situated in the Labt., that is, that you are obliged to be 1st Asst. without the title of Asst. Profr., and besides have the responsibility of filling the offices of 4th Asst. and Laboratory servant. The idea that a man of your qualifications should be obliged to be bottle washer is absurd enough. Silliman writes me that the Labt. is full, if so they can afford, or rather they *must afford*, to have some one to attend to bottle washing and making of reagents. Tin must be raised and the present faults remedied. I wish I was home to work with you, it would be much greater pleasure to me than remaining here. But, Sam, I'll be home about this time next year, and I hope that things will be so arranged that you will "stand by the old shell" until that time. I know, Sam, that it will be a little up hill at first, but I am sanguine that we can build up a better chemical and mineralogical school at New Haven than at any other point in America. You, unfortunately, have the first and perhaps the largest tug at the hard work, but I hope you won't give up. I know that Dana and Silliman feel the vital importance of having you remain, and are provoked beyond measure at the stupidity of the Corporation's blunder of not giving you the title they (the Profrs.) had intended.

You must speak freely and openly about the Labt. to Dana and Silliman, tell them what the faults are and what are the remedies. You have no idea what a high estimate they put upon your opinion. Your weakness, my dear Samuel, is extreme modesty, put a manly face on the subject and speak out your sentiments, and you may be sure they will meet with the deep consideration which they deserve. . . . Stand by, old fellow, and my word for it you'll not regret it. You must have a Professorship, and it must be endowed.

Mr. Johnson found New Haven a delightful place of residence, but he felt the absence both of opportunities

and facilities for doing the special work for which he had so laboriously prepared himself. This dissatisfaction led him to look for a position elsewhere; he was seriously considering the possibilities of an agricultural school in Pennsylvania, which might give him the field he wanted in conjunction with Mr. Pugh, and also employ the business talents of his brother-in-law, Mr. Easton, who was still hesitating before breaking all family ties in the East and casting in his fortunes with the newly opened Northwest. In this connection Mr. Easton wrote:

If there is a reasonable probability of doing what you suggested with your Philadelphia friend and my services are wanted at a reasonable living price for the farming and business department, I shall hold on and look to that as my future business. Of course you have nothing tangible as yet on the subject. . . . I see your things in the *Country Gentleman*. Go ahead, agricultural science is your missionary field and you are responsible to the amount of some talents for its cultivation. You are making some reputation by your position at Yale College, and still more perhaps by your articles in the papers. This is all right and I am proud of it. I expect, if you live, to see you *some* one of these days.

When Mr. Johnson visited Albany in September, he found Mr. Tucker and his other friends in the New York State Agricultural Society still anxious that he should join their working force in that city. This society had been founded in 1832 by J. D. Le Ray de Chaumont; from the first it counted among its members men who believed in the possibilities opened by science to the advancement of agriculture. When the work of Justus von Liebig began to be known in this country, and it became evident that chemistry was to

revolutionize the conception of the processes involved in plant growth and of the nature and sources of food needful for the growing plant, these few far-seeing men, who realized what might be accomplished for agriculture through chemical knowledge and experimentation, had quietly set about the work before them. Through their efforts, in 1840, the New York State Agricultural Society adopted a new constitution and secured a Legislative appropriation of \$8000 per annum. In 1857, contrasting the conditions in New York with the apathy in Connecticut, Mr. Henry A. Dyer said:

In New York the Agricultural Society is the institution of the State that all political parties delight to know, and the strife, so far as *it* is concerned, between rival factions is which shall give itself the best hold upon the general approbation of the State at large by most heartily advancing the operations of the Agricultural Society.

Dr. Ezra S. Carr, chemist to the New York State Agricultural Society, was also actively engaged in furthering plans for the great university. During the fall and winter of 1855, Mr. Tucker and Professor Carr were in frequent correspondence with Mr. Johnson concerning the future prospects of the "University of Albany" and the State Agricultural Society, and their wish that he should leave New Haven for Albany. On October 1, 1855, Professor Carr inquired:

Would it be agreeable for you to come to Albany if some satisfactory arrangement could be made? At present I am chemist to the State Ag. Soc. They will fit up a Laboratory in the new State building the coming winter which will afford all the facilities of a private laboratory for analysis in re-

search. The laboratory at the Med. Col. will answer all purposes of instruction. There are no fees connected with the office of chemist, excepting the charges made for chem. analyses, etc. A good Lab. however will be furnished free of expense, and I think it probable that hereafter an appropriation may be obtained for researches in agricultural chemistry. . . .

I do not know how remunerative this would be; but it has occurred to me that perhaps some connection (as a writer for the *Cultivator*) which you might form with Mr. Tucker, together with the laboratories, might yield a living compensation.

A few days later he wrote again on the same subject, saying:

I have no doubt that your income the first year would be sufficient to defray your expenses, giving you at the same time all of the advantages you could desire in the way of opportunities to pursue your own chemical investigations. I should be happy to give you all of the advantages which a connection with the State Agricultural Soc. would afford, or my own Laboratory at the Med. Col. for giving instruction, etc. It would give me pleasure to have you come here to reside, and I should like to see and confer with you in reference to the matter should you find it convenient.

Mr. Luther Tucker, who had long wished to devise some means by which Mr. Johnson might be enabled to go to Albany and begin work there in the field of scientific agricultural education while waiting for the endowment which they all hoped would soon make the "University of Albany" a reality, wrote these friendly words at the time of an official invitation to speak before the New York State Agricultural Society:

I hope you will, if possible, accept the invitation that you may thus become known to our Society. I brought the subject today, for the first time, of your employment as State Chemist, before the Board in an informal manner. It was well received. . . . In the mean time, if you can give us the proposed address it will help us along very essentially.

In response to the desire of his friends, Mr. Johnson delivered an address before the New York State Agricultural Society at Albany on February 13, 1856, under the title, "The Relations which exist between Science and Agriculture." The main points which he emphasized are here given in his own words:

It has been the success that has followed the application of science to manufacturing arts which has aroused the hope that she may contribute to the advancement of agriculture. It is especially the science of chemistry that has now become the signal means of improvement in a hundred branches of industry, not less than the basis on which alone they can securely rest. . . . Why has not *agriculture* shared in this progress? I answer, it *has* shared therein, though to a less striking and less profitable degree. The arts to which allusion has been made mostly involve only dead or inorganic matter, and their study, thus withdrawn from the dominion of all but the chemical forces, is very easy compared with the investigation of the problems of agriculture which are, of all others, the most complex and difficult. . . .

But there are other reasons than the inherent difficulty of the subject which have prevented the more rapid development of agricultural science, reasons which lie in agriculture itself as it is,—in agricultural practice. One of these is the lamentable circumstance that our agriculture is so barren of facts; I mean that kind of facts which only can form the foundation of science, I mean complete facts. Complete facts are the truth, the whole truth, and nothing but the truth.

All others bear a false witness, false because partial, and cannot be admitted to testify in the courts of philosophy; or, if their deficiencies escape detection and their depositions are received, a wrong verdict will be rendered.

The husbandman has been baffled by the number and intricacy of the causes and conditions that influence his results; his reason has been discouraged and stupefied by its inability to harmonize the various, often conflicting and often hidden, agencies of nature; and the habit has been confirmed through centuries, of adopting maxims and empirical rules as guides in the cultivation of the soil. These maxims have been mostly the result of experience and so far have been correct and satisfactory, but they have been derived usually from a limited experience, have been originally found true only in a narrow district, and the precise circumstances that have made them applicable have not been understood, so that when put into practice elsewhere they have failed utterly; or, what is worse, partially, yet not to such a degree as to lead to their rejection. . . .

The first thing to be done is to multiply facts. This is accomplished by observation and experiment. Ordinary observation takes cognizance of what transpires in the usual course of nature. Experiment is that refined instrument of modern research which *interferes* with the ordinary course of nature, and compels her to unusual manifestations. Observation is the eye that watches her voluntary movements and the ear that hears her willing revelations. Experiment is a wise cunning that cross-examines her and pries out her secret counsels.—

The roughness of ordinary agricultural observation arises, to a great degree, from a want of knowledge as to where lies the gist of the observation, and amounts to an incapacity for observing. What keenness of perception we attribute to the Indian who traces his way through the forest with invariable accuracy by little indications that to us would be undistinguishable. The secret is that he knows *where to look*. He

must be trained to follow the trail of truth. It is so, too, with experiment. There is no lack of agricultural experiments. Unfortunately, however, it is mostly difficult, nay impossible to find any good reason why they have been made, they are so barren of useful results. The empiric experiments at a venture without any probability to guide him. His hap-hazard trials often reveal new facts, but he rarely contributes largely to scientific progress, *because* he makes hap-hazard experiments, because he does not reason. The philosopher experiments with an object in view, and distinctly in view. He does not indulge in small talk with nature, but puts earnest questions to her. The course he follows in the investigation of a subject little known is this: He first collects and collates all the facts known with regard to it. He then seeks to construct a consistent explanation of these various facts. It may be that he finds it impossible to do this. Then he must verify the facts, perhaps some are false or he sees them from an insufficient point of view, or he must collect more of them by extending his observations, it may be by experiment. He shortly is enabled to form a hypothesis, to frame a theory which promises to account for the facts. Yet it is not a hypothesis but truth he seeks, and now he begins to test his theory. Every deduction which he can draw from it must prove true, else the theory is false. He therefore unites the conditions which his theory indicates will produce a given prevised result. If the result follow, his theory is confirmed, otherwise it must be rejected and a new one formed and similarly proved. Here is where experiment assumes its chief dignity and value. Here, it must be suggested by reason or it cannot be expected to answer any good purpose. Here, if rationally devised and skilfully executed, it must reveal a truth, and though the truth be negative it is not the less valuable, for every new negative result limits within narrower bounds the space wherein positive truth is to be sought. . . .

How little is to be expected from mere farm experiments conducted without especial aid from science, the past abun-

dantly shows. In this country there have been established several experimental farms. Upon these farms trials have been instituted to ascertain the relative values of various manures, but the results have not and cannot have any general or permanent worth. They have not been made with more insight, nor have they been calculated to clear up more doubts, than the single experiments carried out here and there by private individuals. It is true they have been executed with more care than is usual, but this has been so much more labor lost. The spirit which has established these experimental farms is worthy of the highest praise, but after they have existed here for years we shall only reap the same fruits that were gathered long ago in Europe, viz., a greater abundance of conflicting fragmentary facts. I do not say that no good can come of them. I only express my belief that the results will be comparatively small, not at all commensurate with the outlay.

The other recognized means of making advance in agriculture is the chemical laboratory. It was in the laboratory that the foundations of agricultural science were laid, and it has therefore served a most useful purpose. There are still many subjects of considerable importance which the laboratory is competent to elucidate alone; but the larger share of the problems that are now needing solution require the laboratory and farm to unite their resources.

There have been lately established in Germany, especially in Saxony, a number of so-called Experiment Stations, or experimental farms with laboratories in connection, for the exclusive object of promoting scientific agriculture. It is but a few years since the first of these was founded, now there exist already four in that little kingdom; and three others are in operation, or are being established, in other parts of Germany. These are intended to make science practical, and practice scientific; and no agency can be desired better adapted for these important purposes. As mere practice is deficient in all that belongs to the province of science to sug-

gest, so science alone lacks that which practice is naturally fitted to supply; each is the complement of the other; rational agriculture is the result of their union. The great laws that control vegetable and animal production being once established by pure science, science in conjunction with practice must apply those laws, must study their bearings and follow out their details. In the field and the laboratory, then, observation and experiment are to reveal to us the new facts which shall be the materials for agricultural progress. . . .

The method I have roughly sketched must inevitably lead to good results, whose number will only be limited by the zeal and skill that we enlist in these great inquiries. Not merely will they be of immediate influence upon our noble science of agriculture—opening to us the mysteries of nature's workings—but, as always happens, the increase of knowledge will react on its diffusion. . . . So it will be with agricultural progress. The interest aroused by the very effort to discover the new will vitalize the old. . . . The intellectual life of the farmer will become more vigorous and healthful. He will cease to be mechanical and prejudiced, and more nearly attain to the true dignity of a wide seeing and deeply thinking man. These special studies carried out on an extensive scale will have the effect to make agriculture appreciated as a profession. Educated young men will be attached to it as an intellectual pursuit. Finally, the influence of special agricultural inquiries, prosecuted as I have mentioned, will be to modify and reform our existing practice generally. The unprofitable and even wasteful management, now not rare in our state, will give place to a more judicious and rational system, conducive at once to the prosperity and beauty of our country. . . .

I have full faith not only that science *may* accomplish much for agriculture in the way I have indicated, but that she *will* be speedily put about the work. The tendencies of our time prophesy this. The notion that there is anything essentially antagonistic between science and practice is daily

meeting its refutation, both in the laboratory and in the field. I may confidently ask, where better than in our own country shall this idea find its realization? The scholars of Europe often say to the American: Science can only flourish under the patronage of Royalty. But they mistake—our country, just arrived at manhood, has indeed been so absorbed in its own growth that it could ill spare effort for great scientific achievements, and yet within the last twenty years, even the self-complacent philosophers of France and Germany have been obliged to be amazed at the contributions to science we have sent over to them from what they are pleased to call our back woods. Our country now has the strength of the oldest nations with all the freshness of youth. She is girding herself up to contest among the nations for the prize of science. What worthier triumph for our republic than to win for her millions the boon of a rational agriculture?

Two notes from a friend in Germany which clearly refer to the “University of Albany” are added here:

München, July 7th/56.—Liebig is again working on something to be published against Lawes, and wishes to know whether you are willing to translate and get it published in the U. S. (probably in an agl. paper). He has almost made up his mind to go to the U. S. and set up a model farm and ag. school, provided one of the states will furnish him with the land and funds. I had a long talk with him on the subject.

Berlin, Nov. 23rd, 1856.— . . . a very small note to ask whether you got that book of Liebig’s which I sent by post from Berlin about two months ago? In the letter which was in the package, I told you of Liebig’s design and firm intention to emigrate to the United States, if he could get a grant of land from the State of New York for the purpose of an Agr. School; his reasons etc. I explained at length.

Mr. Tucker, writing from Albany in November 1856, said:

—We should like to have you take up such subjects, generally, as will enlighten our farmers on the matters which daily come before them; but you need no suggestions on this point. We should prefer to insert your articles as *editorial*, except in cases where you particularly desire to have your name attached, or where from their scientific character, it would be necessary.

I am sorry to hear that there is even a possibility of a failure in your proposed Scientific School. I supposed that such arrangements were made as would secure its establishment on a firm basis. I shall not fail to let you know if I hear of anything to your advantage. Possibly our Ag. College may go into operation—in a year or two. Our State Ag. Society ought to have now funds enough to employ you permanently in a laboratory here, and I cannot but feel vexed when I think how foolishly their funds have been wasted. They are entirely out of funds and have got to live on credit until the next State Fair. We want all the aid we can get from you on the *Country Gentleman*.

Unfortunately the desires of the progressive members of the New York State Agricultural Society failed of realization. The leaders were too far in advance of their time; wise and good as their plans were, they were unable to carry them into effect. It would have afforded Mr. Johnson the keenest pleasure to join these friends of his youth in Albany in such a work for scientific agricultural education as they hoped to establish in the state of his birth, and it was not until all possibility of this had quite passed away that he began to look upon Connecticut as the place of his life work.

CHAPTER IV

CONNECTICUT STATE AGRICULTURAL SOCIETY

Almost as soon as he reached New Haven in the fall of 1855, Mr. Johnson had been appealed to for help in establishing on a substantial basis the *Connecticut Homestead*, which was published at Hartford from 1855 to 1861. The editors of this paper, Wm. Clift, T. S. Gold and H. A. Dyer, served without pay. In 1856, Mason C. Weld became publisher and was added to the board of editors, afterwards becoming editor-in-chief. The paper grew in favor; it was self-supporting when, at the outbreak of the Civil War, Colonel Weld volunteered. About six months later, however, its publication was discontinued. Mr. Weld had, on the 22d of October, 1855, written to Mr. Johnson, asking:

Can't you give us a lift—by *us* I mean the *Homestead*. I have to do pretty much the whole work just now, while the other editors have so much to do in the Fair line. Do you see "*The H?*" We are getting a good circulation. If you want your School cracked up I'll do it for love.

Mr. Johnson's response was a series of articles. These, published in the *Homestead* during 1856, brought his methods and ideas before the members of the Connecticut Agricultural Society, led to an invitation to address them on his recent work in the

exposure of frauds in fertilizers, and resulted in his appointment as chemist to the Society. Since his first official "Report as Chemist," made to the Connecticut State Agricultural Society on January 12, 1858, together with similar work done by him in preceding years without official authority, summarized in his address, "Frauds in Commercial Manures," delivered before the same society in January 1857, is often referred to as the commencement of the Agricultural Experiment Station movement in this country, it is of interest to bring together here some facts concerning Mr. Johnson's connection with the early growth of that idea.

An article—"County Agricultural Institutes"—published during his student days in New Haven, in August 1851, sets forth in a general way his earliest conception of ideas which later assumed a more definite form. This larger vision of the usefulness of chemistry to agriculture came to him before his opportunity to perform the clearly needed, but much narrower, work of fertilizer analysis. It was thoroughly characteristic of the man first to form and tenaciously hold the broad idea, based upon a universal and permanent need; and then, realizing an opportunity for practical work, to set about using his skill and knowledge in routine analysis performed with all possible accuracy in order that these simple analyses should be so absolutely right that they might be an unassailable foundation for the wider work to come after. In March 1853, he published, under the title "Superphosphate of Lime," an account of the results of analyses which he had made on two samples of artificial fertilizer offered for sale. This paper is the prototype of the

Address of 1857 and the *Report* of 1858, and for that reason is given in full as an appendix. The analytical work described in it was probably the first of the kind published in this country. Together with the intelligent and authoritative discussion of the broader aspects of his subject, it laid the foundation of the personal reputation for accuracy, fearlessness and integrity, by virtue of which every utterance of his later years commanded a respectful hearing. Concerning the two brands of fertilizers considered, this investigation gave essentially the same information as did the *Reports* made by Professor Johnson, a few years later, to the Connecticut State Agricultural Society covering a much larger number of fertilizers; and this work, done in his early student days in New Haven, shows that his methods were, to some extent at least, his own, not merely an adaptation of European models due to the influences of his later student life in Germany.

After the publication of "Superphosphate of Lime," two years of study abroad intervened. Almost immediately upon his return to New Haven in 1855, Mr. Johnson resumed his work of analysis and valuation of fertilizers for the information and protection of farmers. This seemed to him the obvious and rational beginning of a larger work which he hoped he could thus prove to be so necessary that farmers would come not only to accept, but to demand it. It gave opportunity to demonstrate to the laity one way in which science stands ready to help practice. The correctness of the view which led him to take up this voluntary personal work is evidenced by its growth into our present American system of fer-

tilizer control, which annually saves the country many millions of dollars by safeguarding the interests of both purchaser and manufacturer.

In 1856, the outlook for scientific agriculture in Connecticut, a manufacturing state, was most discouraging, but Mr. Johnson enthusiastically set about his self-imposed duty, associating himself with the small body of progressive men in the State Agricultural Society, and giving much time to systematic education of the farming community by means of lectures and discussions before farmers' clubs, and by frequent articles in agricultural journals. His lecture, "On the Relations which Exist between Science and Agriculture," delivered at Albany in February 1856, and published in the Transactions of the New York State Agricultural Society, was widely read and discussed. It became a useful missionary leaflet, although it failed of its direct purpose, the securing an endowment for an agricultural experiment station in the State of New York. An article in the *Homestead* of May 29, 1856, "On the Value of Certain High-Priced Fertilizers," together with the two which appeared immediately after it, followed the same general lines as the "Superphosphate of Lime" of March 1853, while embodying the results of study since that date. It was in reference to these articles that he stated in June 1870, in a report as chemist to the Connecticut State Board of Agriculture, "When I first introduced the valuation of manures into this country in 1856, following the example set by Stoeckhardt* in Germany a

* Julius Adolph Stoeckhardt was professor of agricultural chemistry in the Königlische Sächsische Forst-Akademie at Tharandt near Dresden. In 1849 he proposed a method of estimating the values of fertilizers,

few years previously, etc.—” Professor Johnson’s method of dealing with the questions he was presenting to the agricultural public was to explain scientific processes in a thoroughly scientific way, using the simplest English words, avoiding all technicalities, but making sure that each principle was so clearly set forth that it could easily be understood by any fairly intelligent person, however unfamiliar with the subject. Realizing the value of continued reiteration in securing the acceptance of a new idea, he confined himself to insistent repetition of the main facts he was striving to impress on his audience of landowners and farmers. These were: The necessity of employing chemical analysis as the only basis upon which to form an intelligent opinion about the suitable composition of a fertilizer; the reliability of accurate analyses as a guide to the estimation of value; and the importance to the community of a regular system of analysis of all commercial fertilizers as a safeguard against fraud, as well as against the self-deception of ignorance—ideas which, novel at that time, are now universally accepted and adopted, both by manufacturers and consumers, as the basis of the trade in commercial fertilizers. He gave careful explanation of all analytical processes, the reasons for them and the results obtained; then, following the method of Adolph Stoeckhardt, he “valued” the fertilizer analyzed as an assayer values an ore, by assigning a money value to each essential ingredient, and from their proportion, as found in the sample, deducing a market value for the fertilizer.

which was soon adopted by the chemists of the agricultural societies of Great Britain.

The rather remarkable fact is to be recorded in this connection, that, although private interests were thus attacked, the sincerity of his motives and the accuracy and honesty of his work were never seriously questioned. This series of articles in the *Homestead* attracted much attention; the "showing up" of the fertilizers considered caused his analyses to be widely copied and commented on, and gave rise to correspondence on the subject. Mr. Johnson kept a copy of a letter in which he defined his position in the matter—this letter was written in answer to a vigorous remonstrance and appeal from his results, addressed to him by the agents for one of the brands of fertilizers which he had analyzed and described in the *Homestead*:

New Haven, Ct., June 13, 1856.

Gentlemen,—I received today your letter and sending of ——— Guano. All the analyses I had intended to make are already in progress. I cannot therefore examine the specimens you have forwarded, especially as they are so similar in appearance to those being examined and as it is not claimed by the Company that they have more than one kind of Guano. I would readily extend the number of analyses were it necessary in order to promote the end I have in view. The concurrent testimony of my own results (not yet quite complete), and those obtained by no less distinguished a chemist than Dr. Anderson, chemist to the Highland and Ag. Soc. of Scotland, and by Prof. Campbell Morfit of Baltimore, is that the analyses you publish in your circular were either made on different specimens from the authentic ones I have been examining, or that the analyses have been stated in an inaccurate manner, or at least in a way calculated to deceive persons not familiar with chemistry. You will perceive this involves a mistake, some will think a fraud, either in the

Company or among the chemists who have analyzed it. It needs very little chemistry to demonstrate that every one of your published analyses is either inconsistent in its chemistry, or incomplete and unsatisfactory for agricultural purposes. The estimate of its value by Dr. Stewart is very, *very* wide of the true mark. In a few weeks it will become my duty, in pursuance of my declared purpose, to publish my own results and criticise the contents of your pamphlet. It will appear in the end that you have a capital source of phosphoric acid, but not of soluble superphosphates of lime, and that you charge too high a price for it. If you desire that specimens sent (any or all of them) be analyzed, that will be done in this Laboratory not by me, but by an assistant who has that branch of the business in charge, and the results will receive the endorsements of and comments of Prof. B. Silliman, Jr., or of Prof. John A. Porter, or both of them as you may wish.

I am not *Professor* but am 1st assistant in chemistry; my duties in connection with the Yale Analytical Laboratory are to superintend the courses of instruction in analytical and practical chemistry. I am not at liberty therefore, you perceive, to undertake analyses on my own private account for fees, nor is it desirable that I should accept any favors from either dealers or consumers which would invalidate my claims to disinterestedness in the discussion that has just begun.

I have been assured by parties whose opinions I respect as honest and unbiased, that the company owning the —— Guano is a body of reliable and fair men and intends to do the right thing. I regret, therefore, that on them will fall the discredit which must attach to overrating this Guano, although they are free from blame. But in my published articles I cannot attempt to decide *where* the blame lies. I have simply to publish facts and my own deductions. I cannot say to you, being strangers, that my analyses are right and those of the other chemists are wrong, and recommend you to change your prices and claim less for the guano, for it would be easy to ascribe such an act to the lowest motives.

Nor can I presume that my dictum will weigh in your opinions against the testimony of so many chemists who have long been considered reliable. My only plan, then, is to publish my results uninfluenced by authorities,—to question no man's motives, and in the conflict that must inevitably arise as to the merits of manures and of analyses, involving of course the reputation of dealers and chemists, I have to defend myself as I can with truth, or failing, be silenced.

As my analyses are not finished my opinions founded on them and here expressed are only provisional, and you will therefore please not to use them in any public manner. Yours faithfully,

S. W. Johnson.

Mr. Joseph Harris, editor of the *Genesee Farmer*, sent these words of approbation on July 13, 1856:

I am glad you have undertaken the analyses of the various artificial manures. It has long been wanted. I fear you may get into trouble. I have had one or two letters already speaking in no very flattering terms of the *writer in the Homestead*. Your method of estimating value is doubtless correct, but I think you will find no manure in this country that, according to this estimate, is worth the money charged for it.

Henry A. Dyer, a student in the "Old Lab." in 1851-52, was associated with his father in extensive agricultural enterprises in Windham County, Connecticut. At the organization of the State Agricultural Society he became its corresponding secretary; he was also largely concerned in the establishment of the *Homestead* in 1851. Late in November 1856, Mr. Dyer wrote to Professor Johnson:

Mason C. Weld has started a project . . . in reference to the Annual Meeting of the State Agricultural Society. He proposes to have the meeting more after the order of a delib-

erate scientific convention than a mere business meeting of the Society . . . —papers to be read, and such discussion upon them and subjects they may suggest to be duly chronicled and put in print as portions of the Society's Transactions for the year. Will you come up and help us? You will give me a paper this year for the Transactions, and had as well come up and read it. . . .

On January 7, 1857, at the annual meeting of the Connecticut State Agricultural Society, at Hartford, Professor Johnson spoke, in part, as follows, his subject being "Frauds in Commercial Manures."

Almost within fifteen years, a new and extensive business has sprung up in those countries whose industrial development is most rapidly progressing; viz., the trade in concentrated and costly fertilizers. . . . Can we command the supplies we need without fear of fraud? In answer to this question, I may reply: At present the farmer is entirely at the mercy of the manufacturer or dealer. . . . But before going further let us inquire: What is fraud? We must, as farmers and business men, answer this question with pure reference to our own interests, without at all considering the motives of those who defraud us. A fraud, then, is selling to the farmer an adulterated or damaged fertilizer of established name: or imposing upon him worthless or inferior fertilizers, under names calculated to deceive and at exorbitant prices. When, in short, the farmer does not get from the dealer the value of his money, or the kind of materials he bargains for, he is defrauded. The readers of the agricultural papers know the history of the Chilian guano fraud, which Joseph Harris, Esq., now editor of the *Genesee Farmer*, detected and traced to its source with so much fearlessness and ability. The results of my own numerous analyses of manures which have been published in the *Homestead*, during 1856, show undeniably that there are yet among us those who think the farmer

fair game for their plucking; and if any are disposed to excuse the dealers generally from intention to defraud, the matter becomes pretty plain when certain of them who have never denied the accuracy of the analytical results—thus virtually admitting their justness—covertly try to intimidate agricultural editors from copying them. I will, however, tread no nearer this dangerous ground. I will not attempt to specify what are the current frauds which have their root in rank dishonesty. It is vastly pleasanter to suppose that frauds are mistakes rather than wilful attempts to cheat; but it is of the utmost importance to know whether we are liable to be intentionally as well as accidentally imposed upon, and when we have satisfied ourselves on this point, we may drop the subject of malicious fraud, as our business is not to retaliate for the past, but to protect ourselves in the future.

Now, were the only frauds liable to be inflicted on us those coming from evilly disposed persons, we should have a remedy by finding out who are the honest dealers, and giving them our exclusive patronage. But we are cheated by honest men! We have no security in any man's reputation or conscience. What the villain leaves, is stripped from us by ignorance or blundering carelessness. There is such a looseness and wretched want of thrift in some points of the trade in fertilizers, that we are hardly sure of the genuineness of any thing except Peruvian guano, and after that we must henceforth look more sharply than hitherto. Indeed so many false ideas are afloat in the community, and there is such a lack of precise and grounded information relative to manures, that it is really difficult to draw the line between ignorant and dishonest frauds, and great caution must be employed in charging any one with villainy or deceit. In case of such a fertilizer as superphosphate of lime it is even difficult to establish a just standard of quality, for the name has had such license, has been applied by manufacturers to such various mixtures, that we never know what we are buying, except by analysis. Of all the superphosphates I analyzed last year, not one came

up to a reasonable standard of quality. One was an absolute misnomer, it contained no superphosphate of lime. Only two were at all worthy to rank under the name, and I must here say that one of these superphosphates withstood a severe test. . . . Of all the other high-priced manufactured manures which have been twice analyzed, not one has maintained a uniform composition. In most cases the later analyses have demonstrated a serious falling off in the quality of the article.

So much for what has happened. Can we expect better or worse treatment in the future? Doubtless the battle is but just begun. The business is established, and new manufacturing will spring up like mushrooms. There is a class of deceptions in all departments of trade which are not flagrant, and have been overlooked and winked at until now they are recognized as general and almost legitimate. It is your duty and for your interest, farmers of Connecticut, to see that there be not too many "tricks of the trade" introduced into this new business. Abuses speedily get sanction, or get beyond the reach and effect of remonstrance. If we do not master them, they will master us. We must say to the dealers: We know what we want and you must fulfil your promises. We will not be humbugged either by your names or your prices. If we cannot know what it is we buy, we will not buy at all. We will thankfully purchase from a fair dealer and pay him a fair price; but woe to him that attempts to defraud us!

There is but one way by which we can effectually protect ourselves and be sustained in using the above language. It is the resources of the science of chemistry which in their recent development have made possible the judicious manufacture and use of concentrated fertilizers. It is the same useful science which alone can reveal the frauds which may creep into their preparation. It is principally the recognition of this truth which has led the chief Agricultural Societies of Great Britain and Germany to employ scientific men to analyze manures for their members. . . . This plan works well in Great Britain because the British farmers who

use artificial or costly manures are always able to pay for an analysis, but in this country a different procedure may be advantageously followed; a procedure which, with far less expenditure, will prove more efficacious. This plan is one adapted to be carried into effect by your State Society, and is as follows: Let a trustworthy chemist be employed to analyze every year all the various manures that come into the Connecticut market. Let the analysis be made, not on samples forwarded by the dealers, or manufactured *for analysis*, but on specimens procured by farmers themselves, such as shall fairly represent the article that is spread upon the fields. These samples should be procured from different places, and the same manure should be repeatedly examined in order to test the uniformity and reliability of its composition. The analysis should be repeated every year, so that all improvements or deteriorations in manufacture be kept pace with. The results should be published in the organ of the Society, so that all its members be informed what are good fertilizers, and what are trash. With this system in skilful operation, an honest dealer would sell his commodities nowhere more gladly than in Connecticut, for he would be sure of finding for them here a full and enlightened appreciation, while the rogues would send their wares to some other market; the risks of detection would be too great for them to encounter.

There remain a few points to be noticed. While the farmer assumes an independent attitude toward the dealer, and shows that he can defend himself from fraud and imposition, he must not go too far and become arrogant or exacting. He must accord to the manufacturer fair profits, and, living himself, let his neighbor live. Another point;—a most careful distinction must be drawn between the commercial and the manurial value of a fertilizer. The former is told by chemical analysis, the latter by trial on the field. When, therefore, chemical analysis has decided upon the commercial value of a given fertilizer, it is not just that the manufacturer loses his reputation and his business because his manures fail, or

appear to, on some farm or throughout some districts. The manufacturer has for his duty to know how to make, and to make, reliable fertilizers. It is the farmer's duty to know how to select and how to apply them to his soil. If any dealer profess to sell a manure that is useful on all soils, all crops and in all climates, he professes too much; and if any farmer expects any manure to be similarly useful, he expects too much. The very reasons that make these fertilizers sometimes and, in some places advantageous, prevent them from being always and universally so.

Finally, it is well to try to discover what is the significance of this new activity in matters relating to agriculture. It means that the doctrines and practices of farmers are rapidly undergoing change and improvement. It means that the farmer has been inquiring and reflecting, and has determined on a wider range of enterprise. It implies, too, that this progress of opinion and action will go on indefinitely, widening and intensifying without limit, and will result in the most exalted benefits if it be duly fostered and guided. It strikes me that of all influences, none will ever be found more efficacious in bringing about the harmony and coöperation of science and practice, than this same traffic in manures. It will be efficacious because it will bring the parties closely together and make them acquainted, and when they once get to know each other fully, there is no fear that they will ever indulge in mutual abuse, or part company again.

Just before the delivery of this address, Professor Johnson was elected chemist to the Connecticut State Agricultural Society. A few days later came these pleasant words of appreciation from Mr. Tucker:

I congratulate you and the farmers of Connecticut on your appointment as Chemist to the Conn. State Ag. Society. If wise counsels prevail, something good and permanent in its effects may be looked for from this small beginning. I have

very deep fears that our Ag. College will not accomplish the mission to which it is devoted. . . . I hope you in Connecticut will accomplish something in the right direction.

Professor Johnson's contributions to the *Country Gentleman* during 1857 were chiefly translations and adaptations from foreign journals and, while signed, were more or less editorial in character. They were designed to give their readers the results of the best European thought on agricultural matters. In his preface to a translation of some of Boussingault's researches, he makes the following plea for the training of research workers in agricultural science in this country:

I have thought a perusal of these researches by Boussingault, a man whose devotion of wealth, genius, and life to the study of agricultural chemistry and physiology has greatly enriched the science and the art of husbandry, would be of interest for several reasons. In the first place, they illustrate the *method* by which we are to arrive at a knowledge of the conditions of vegetable growth, and the influence of fertilizers, or of other circumstances, on the development of plants. Again they reveal some new truths in a broader and fuller light, and in this respect form a valuable contribution to agricultural science. Finally, they may serve to excite the reader to a more extended study of the subject of vegetable nutrition, a subject which lies at the foundation of agricultural production.

Twenty years ago, nobody, neither farmer nor philosopher, knew what was the function or value of ammonia, or of nitric acid, or of the phosphates, as aids to vegetable production. Now, we do know that these bodies are all indispensable to the growth of plants, and we are able to comprehend, in some good degree, the reasons of their value. It is to investigations of the kind that have just been laid before the readers of the

Country Gentleman that we owe this advancement. It is easy for any one who has begun to master agricultural science in its present state of development, to see that what has been accomplished is but the entrance to a vast and fruitful field of research, wherein even now may be seen luxuriant harvests of truth nodding for the reapers. Alas, our country, which it would seem unites every requisite for making a successful husbandry of these golden stores of intellectual and material wealth, has hardly gleaned the first ripe ear. England, Germany and France monopolize these treasures. Haven't we energy, genius and culture enough to equip a few laborers for the noble enterprise of laying open to the world these granaries of knowledge? Haven't we wealth that is ready to be devoted to sustaining their slow and toilsome efforts? What is the matter, that with all our enterprise and reputed keenness in foreseeing every event that promises profit, we allow the slow Old World to keep out of sight ahead of us on this track, that assuredly leads to the most honorable glory and to the substantial reward of increased national wealth? Is it a fact that we don't appreciate the possibility and the advantages of improvement in the most vital parts of agriculture? What sums are we not willing to expend in inventing, testing and using machines for reaping our grain—but who would be rich for possessing all we have devoted to acquiring a certain knowledge of the means of raising the standard of agricultural production to its highest limit?

Professor Johnson's first "Report" to the Connecticut State Agricultural Society is dated January 12, 1858. In the letter transmitting it, he thus sums up the work accomplished:

In some instances where it facilitates the study or appreciation of the results, I have devoted some space to elucidating the chemistry and general bearings of my subject; . . . As the Connecticut State Agricultural Society has for

its object to develop not only the agricultural, but all the industrial resources of our State, I have alluded to the successful employment of peat in the manufacture of various useful products employed in the arts, and to its uses as a cheap and efficient fuel. I have deemed it due to the Society as well as to myself, to describe the methods I have employed in my analyses. This . . . will enable men of science to judge of the reliability of the results I have laid before the Society. I have at the conclusion of my report alluded to some other important subjects of investigation which might be undertaken with advantage. Before entering into the account of my analyses of manures, I must state, what you can testify to, that since my appointment a year ago as chemist to the Society, it has been difficult to find in all our markets any positive impositions upon the farmer in the way of fertilizers. Accordingly the *éclat* of showing up glaring humbugs is not a distinguishing feature of my labors during the last year. I trust, however, that the comparative freedom of our State from fraudulent manures is a sufficient recompense for the fund which the Society appropriated to my investigations. Finally, I have prefaced my Report with some general considerations relative to the nature, uses and abuses of manures, which I hope will be of service in guiding to their judicious application.

The comment of Dr. Dyer, secretary of the Society, on this report was:

The action of the Society at the last annual meeting, in securing the services of a chemist, has proved efficient beyond the expectations of the warmest friends of the measure. . . . During the past year scarcely one very inferior or worthless commercial manure could be found in Connecticut. Manufacturers or dealers who could not with safety warrant their manures have sought other markets. . . . The work already bestowed upon the peats alone could scarcely be had of any professional chemist for the whole amount of our appropria-

tion to Mr. Johnson. We owe it to his interest in agricultural development and to the unusual facilities which his connection with the chemical and agricultural department of Yale College furnishes him, that we have secured so much. The State Society can not afford to lose the honor and reward of carrying out these investigations in the future on a greatly extended scale. With fraudulent or inferior manures we shall have little to do henceforth if we continue to employ a chemist; and if the State Society can not from its own fund continue and increase the chemical grant, it is much to be desired that by private subscription it should be done. Connecticut cannot afford to give up this measure which has already in our own country and abroad given her signal honor. . . .

This report of Professor Johnson made a profound impression among those interested in agricultural matters. While an amplification of earlier work, adapting to American needs methods already in use in England, it was original in many ways; and the personal note it struck persistently, though with modesty and wholly without self-consciousness, is interesting to look back upon. This personal relation between the man who was trying to help and protect others through his knowledge and the hearers who believed him, and trusted in his honesty and sincerity quite as much as in his knowledge, never changed. They were ready first to learn from him and then to join with him in the work; and to the end of their lives he and his early friends in the Agricultural Society labored together, under changing conditions, for the public good.

In 1859, the delivery of a course of lectures in Washington (before the Smithsonian Institution) on "Agricultural Chemistry" gave Professor Johnson a wider

reputation as a lecturer. These lectures embodied the results of his studies and teaching, and covered in a general way the state of knowledge at that time of agricultural chemistry. Personally a quiet, reserved man, whose indifference to outside matters was often mistaken for shyness, once on the platform he completely lost himself in his subject, and made it alive and fascinating. Always carefully prepared to speak, he seldom wrote out anything for publication until after it had been delivered, so his verbal presentation had the freshness and charm of an apparently impromptu wording. These lectures, revised and published, served the author as groundwork for the more important treatise, "How Crops Grow," with which he was already occupied, although it was not ready for publication until nearly ten years later.

His "Second Annual Report as Chemist to the Connecticut Agricultural Society" presents an account of a thorough investigation of peat and muck—more time-consuming than would seem possible save to one familiar with research work. The fertilizer analyses for the year proved in a gratifying manner the good effects produced by the exposures of frauds, made two years before, and bore out the contention that publicity given to results of regularly made analyses would keep up the standards of manufactured articles. With the report he sent this letter to the secretary of the society:

Dear Sir,—My second Annual Report is chiefly occupied with the results of the Investigation of Peat and Muck, begun at your instance in 1857. In order to make my analyses and inquiries of the greatest practical benefit to our farmers, I have prepared a systematic and brief, though pretty com-

plete, account of the nature and uses of Peat and Muck, in so far as they concern Agriculture, the careful study of which, I hope, will enable any one to employ the abundant contents of our swamps with economy and advantage. I had intended to give here an account of the other technical applications of peat; but since it appears that they are as yet very undeveloped and not likely to be of much immediate importance in this country, I have concluded to leave them unnoticed for the present.

The Commercial Fertilizers that I have examined, with two exceptions, have proved to be of good quality, while some of them are new and possess much interest. Samuel W. Johnson.

New Haven, Ct., January 12, 1859.

In June, Professor Johnson again reiterated an admonition to the farmers of the state to beware of setting experience in opposition to scientific truth, ending with an appeal for the support and extension of the work of the Agricultural Society—and that it might surely be read by those he wished to reach, he took advantage of a current controversy in the agricultural press and called this article “American Guano.” An extract from it follows:

Ever since it has been possible to benefit agriculture by applying the discoveries and principles of science to its operations, science has been confronted by the appeal to experience, as to something utterly opposed to and more reliable than her teachings.

Every farmer cherishes his experience because it is his own and dearly bought. His time, his labors, his money and his anxious thought have been largely swallowed up by all-consuming experience; which, like his own live stock, eats enormously more than it lies on. The farmer has a right to cherish his experience. But whoever hints that experience

is better than or opposed to scientific investigation is a sophist, "and the truth is not in him," because scientific investigation is experience, is not opposed to, but harmonizes with it, is not less, but rather greater than ordinary experience, since it expressly seeks to winnow away the error it is well known so often accompanies truth; while *experience* is many times unsuspecting, blind or prejudiced.

If any one lets alone the results of scientific investigation, to depend upon ordinary experience, he lets alone the oldest, widest, fullest, most thoroughly criticized and truest experience wrought out in the lives of the world's most gifted and most laborious men, to sustain himself upon the shallow, unsifted and conflicting experience of those less qualified to observe and judge. *Science is but another and the true name for all that is good in the experience of all men*; and bears the same relation to ordinary experience that the clean grain does to the crop in the field, where there is chaff, straw, stubble, roots and weeds. Common experience is the native, rank, but wild, growth of knowledge. Science is its trained and cultivated development. Common experience is swaying to and fro with every wind of doctrine, unsettled, unreliable; here asserting a thing, there denying it; now believing, now skeptical. But scientific experience is that whereon one may most surely rest, for it reveals the changeless and perfect laws, in whose obedience Nature glorifies her Author.

Your correspondent derives his estimate of the value of American guano from *experience*. That is precisely the source whence mine is derived. He asserts that "the experiments made by farmers with this guano prove it to be the most valuable fertilizer ever brought into this country." I am prepared to show the experience of agriculture has not proved this statement true. I am confident that overwhelming evidence can be produced to the contrary, and am ready to discuss that point with him or any one. Your correspondent believes that the *natural combination* of the phosphates and sulphates of lime, is a reason why the American guano

is "preferred by plants." Unfortunately for this "doctrine of a theorist," the first cargoes with which the published experiences have been made, and upon which the reputation of this manure has been built up, appear from the analyses of Torrey, Gale and myself, to have been nearly free from sulphates—to have been in fact, nearly pure phosphate of lime! In all the numberless trials on record made with the special object to learn the value of various fertilizers, there has, as yet, been found no jot of evidence that any "natural combination" of two fertilizers exceeds an artificial one in its effects, and your correspondent must adduce some evidence, some stubborn fact, to sustain his view; for neither science nor experience is to be convinced by his assurance that the roots of plants, if questioned, would *probably* tell the farmer that they prefer American guano, because of the "natural combination" of phosphate and sulphate of lime. The *fineness* of the American guano would be certainly in its favor, were it chiefly a phosphate of lime, but it is wrong to assert that such fineness is any advantage in case of a sulphate of lime, or that the roots of crops have to "*struggle*" to obtain sustenance from the coarser particles of Nova Scotia plaster, which, as sold for agricultural purposes, has, for the plant, a high degree of solubility.

That American guano has in many cases equalled and excelled Peruvian guano is very likely true for simple and obvious reasons, independently of the testimony of farmers. That plaster, common salt, leached ashes and other fertilizers, have equalled and excelled Peruvian guano is also true. We cannot, however, claim for the last named substances a superiority over Peruvian guano, nor can "D. R. S." claim such superiority for American guano. It is a principle recognized by all thorough agriculturists that whatever a soil or crop *needs* is the most valuable application to it; it may be phosphates, it may be sulphates; it may be salt, or water or sunshine. It is well known that the repeated and exclusive use of Peruvian guano, of plaster, of salt, of lime or of any one

fertilizer that contains but two or three active ingredients, exhausts and temporarily ruins many a soil. But if, where ammonia compounds have nearly run their course and cease to produce remunerative crops, phosphates be applied, it often happens that a good yield is immediately secured; and when phosphates begin to lose their efficacy, sulphates, yea, "legitimate plaster" comes in like a panacea, and fertilizes so that *experience* is astounded.

The "intelligent farmer" ought to know whether it is sulphates, phosphates, drainage or tillage, that his crops need; it is not hard now-a-days to learn these things, and knowing it is sulphates, he can speedily decide whether Nova Scotia or Jarvis Island be the cheaper source; if phosphates, the analyses which tell the composition of what is in the market will be his guide; and henceforth, as heretofore, he will regard, and it is to be hoped, support, his "scientific protector," the State Agricultural Society.

In the summer of 1856, when Mr. Johnson was appointed professor of analytical chemistry in the Yale Scientific School, he found no funds available for books or apparatus—the laboratory was an old dwelling-house in much the condition in which the last tenant left it, unsuited to scientific uses. In addition to the administration of the analytical laboratory, Professor Johnson taught theoretical chemistry, then called "chemical philosophy"—late in 1857, agricultural chemistry was added to his professorship; from then on he offered regular instruction in this branch also. The Agricultural Society and the Yale Scientific School were still most intimately connected, the chemical and agricultural courses of the school being highly approved by the more progressive landowners of the state, and so Professors Porter and Johnson took advantage of the organization of the Agricul-

tural Society to secure audiences for their plea for aid to the Scientific School, which was at this time struggling to maintain a precarious existence without endowment. Two letters, the first written from the home of Mr. Paris Dyer of the "Raspberry Hill Nurseries" in Windham County, Connecticut, and the second from "Cream Hill," the inherited estate of Dr. S. W. Gold at West Cornwall, Connecticut, give the itinerary of two of these frequent journeys of missionary endeavor:

Brooklyn, Conn., Sept. 22d, 1859.

Dear Father and Mother,—Day before yesterday I began a tour of agricultural observation through this state. I attended yesterday the place where a horse fair ought to have been but for the bad weather, viz. Rockville, Tolland Co. 15 miles east from H't'fd. Today I attend what little the rainy day allows of the Windham Co. Ag. Soc. I expect to make a little speech if there collect people enough at the Soc's banquet. I am stopping with Mr. Dyer, Sec'y of the State Ag. Soc. at his father's house, where the big open fire makes shine and dry weather in-doors, although outside all is drizzle and drip. Next week I shall visit the Hartford and Fairfield Co. Ag. Shows. The week after, the Tolland Co. show and the New Milford (Litchfield Co.) town show. Now I shortly shall go to the fair grounds, and see the mud and rain of Windham Co., with an occasional animal and a produce or so. With much love, Samuel.

West Cornwall, Litchfield Co., Conn., Nov. 2d/59.

Dear Father,—I write a hasty note this morning to acknowledge the receipt of the \$100. which came in due time. I am on a month's tour among the farmers of Conn. and expect to speak every evening of the week except Sat. and Sunday. Professor J. A. Porter is with me and pays the shot. To-

morrow night I shall be in Goshen and Friday in Litchfield town, tonight in Falls Village in Salisbury. Last night in Cornwall and Monday eve. in Kent. I like and am liked. . . . I am in the midst of talk about crops, etc., etc. A ruta-baga of 21 lb. weight is in the room, and in a few minutes we must be off for Falls Village. Goodbye, the wagon is at the door.
Your affectionate Son.

Here are some family letters of this period:

(S. W. J. TO A. W. J. AND E. J.)

Yale Analyt. Laboratory, Nov. 27th, 1855.

Dear Mother and Sister,— . . . Last night a copy of the Cortland Co. *Republican* set me thinking that letter writing time had come. I work hard, eat well and sleep sound, my digestion is good and brain clear, my fingers are dirty and sore and my hair long, my shirts are in good order and my every day coat worn out, my wants are few and my means fewer. I sometimes go to see the ladies but they never come to see me.—But enough of this.

Last evening I dropped in at Mr. Bacon's an hour or so, and had a most pleasant chat with Mrs. B. and her eldest daughter. We are having any quantity of lectures here from all the notabilities, Saxe, Holmes, Bayard Taylor, Thackeray, R. W. Emerson, R. H. Dana and smaller fry innumerable have lectured, and are to lecture, at the rate of 3-4 pr. week and dog cheap. I bought a ticket for 12 lectures at \$1.50, and any single lecture is accessible for .25c.

Farewell now, let me hear how you come on. Be happy, and get well. Affectionately, Samuel.

(A. A. J. TO S. W. J.)

Deer River, August 1st, 1856.

Dear Son,—Lucien returned from Minnesota one week ago this evening. Giles C. Easton started last Monday morn to

go to Chatfield, Fillmore Co., Minnesota, where Jason has established a land or broker office for buying and selling to get gain, so that Jason can come home and harvest 30 or 40 acres spring wheat and other grain, settle up his affairs and in the fall go back. He expects Sarah to go with him. How Sarah will like his arrangements, I can't tell. I think not very well, but I shall advise her to go. It seems unnecessary to break up and leave their pleasant residence—fitted up in good style—amidst a circle of respectable friends, in a good society with excellent religious and educational privileges. . . . What privations will not men endure for the sake of Earth's treasures! . . . I received the *Homestead* you sent, it is a good paper. Our love to you, Affectionately,

A. A. Johnson.

(A. A. J. to S. W. J.)

March 13th, 1857.

Dear Son,—It has been a long time since we have heard from you, and longer since you have written. I suppose your time and mind are extensively occupied in your profession, and would not make an unnecessary draw upon your time. I think you should relax often enough to write and let us know how you are, to relieve us of our anxiety about your health. We somewhat fear you may overtax your energies and cut short your usefulness and perhaps your life, by too close application. We hope you will pursue a judicious course. Your mother and Elizabeth expect to come home next month to see Sarah before she goes to Minnesota. She had a letter from Jason today, dated 21st ultimo. He wants her to get boxes made and everything packed ready (soon as navigation opens) to be forwarded, as he can't stay long in Lewis Co. He is as much engaged in getting riches as you are in getting knowledge and imparting it to others.

I feel greatly obliged to Giles and you for Rev. Mr. Huntington's twenty-six Sermons for the people. I have read

nearly all of them, I trust to some profit. I had a small ice house made last fall, and day before yesterday had it filled. Our love to you, Affectionately, A. A. Johnson.

(S. W. J. to A. A. J.)

New Haven, Jan. 22/58.

Dear Father,—I have been working rather closely for a month back, and am still very busy but trying to take it easier. In business matters I flourish pretty tolerably. Last year my income was:

From Laboratory	\$ 615
“ State Ag. Soc.	400
“ Co. Gentl.	125
“ Essay in N. Y. Ag. Soc’s	
Transactions	30
	<hr/>
	\$1160

But I have to work it like a beaver, and keeping up my library,—so as to be able to work to advantage,—costs me considerable, so that my surplus is only about \$300. Doubtless within this year I shall be provided with a salary from college of \$1200 and then the extras will count up. So much I have written to show how the bread and beef are furnished. The State Ag. Soc. at their annual meeting two weeks ago reëlected me chemist at the same salary as last year, and Gen. Pratt declared *he was not my enemy* but voted for me as did everyone else. The Lab’ty flourishes, being as full as ever before, we have 12 paying students. . . .

Professor Johnson, with those of his brothers and sisters who lived near, was in attendance the next July, when the citizens of Lowville unanimously extended the hospitalities of the village to former students and teachers who returned in large numbers

for the semi-centennial celebration of Lowville Academy. During this visit to his old home, he announced his approaching marriage in a note to Professor Brush:

Lowville, Lewis Co. July 27/58.

My dear George,—I have a piece of good news for you. I am in fair prospect to become a married man. I am engaged. . . . Now I intend to get recruited for a splendid year's work, and you must stir up the folks to get those funds raised for I don't care to delay my usefulness as a married man. I only wish I did not stand, as I seem to, in your way,—it is time you too, were paid for your work. . . . S. W. J.

On October 13, 1858, Samuel William Johnson married, at her father's home, Elizabeth Erwin, daughter of George Hunt and Sophronia (Spencer) Blinn, of Essex, New York. A few weeks after he had brought his wife to New Haven, Mr. Abner A. Johnson sent this letter, an affectionate reminder of the intense interest he took in the welfare of all his children:

Deer River, 10th Decr., 1858.

Dear Son,—I have not forgotten you, nor do I believe you have forgotten your father. You doubtless have much to occupy your mind. It is right and proper that every one should be well employed in doing good and being useful, in bettering the condition of our fellow-beings in the concerns of the present life, in making improvements. In many things surely this is an age of improvements. The steamboat was a wonderful achievement in 1807. Soon followed the Erie and Champlain Canals, completed in 1825. But who thought of five hundred or more persons in ten or twenty coaches flying on iron rails at the rate of 30 or 40 miles an hour without horse or mule, but more than twenty years ago was that event

consummated. Then the electric telegraph soon followed, and within a few months has connected two continents altho' there is a temporary derangement. Yet the cable will likely do its office work in time. Lesser improvements, yet of great value; such as labor saving machines, of which threshing, mowing, sowing and plowing are the most prominent. Improvements in agriculture, manures and a long list of etcetera. It would seem that the Lord is lavishing temporal blessings in great abundance upon Christendom, and particularly upon that part now protestant. "Has God so dealt with any other people?" A similar enquiry was made in regard to ancient Israel,—and they forgot God, and where are they now, "a people scattered and peeled." May they prove a warning to the people of these United States.

It is my daily prayer that you and your beloved wife—and all our children—may be a blessing to the circles they move in. Your affectionate father,

A. A. Johnson.

CHAPTER V

SHEFFIELD SCIENTIFIC SCHOOL: "HOW CROPS GROW"

A course of agricultural lectures, arranged by Professor John Addison Porter, was given in February, 1860, under the auspices of the Yale Scientific School. Twenty-six gentlemen from different parts of the country took part in the instruction given; fully five hundred persons came to New Haven in attendance upon the course, including a large number of young and a still larger number of old farmers. The daily lectures and discussions were made widely known through the New York City, as well as the local, papers, and were afterward collected and published in book form. This Scientific Agricultural Convention not merely gave impetus to the local effort for agricultural education, but aroused throughout the country a wider interest in this subject. The lectures of Professor Johnson and Mr. Eaton were generally regarded as the foundation of the course. Professor Johnson lectured upon the chemistry of the plant, the proximate organic principles of the plant and the atmospheric food of the plant.

The year 1860 was a crucial year in the affairs of the Yale Scientific School. The Morrill Land Bill had been vetoed by President Buchanan. Hope of an endowment from this source was consequently deferred, and the small prospect of State aid in the immediate future gave deep anxiety to the school's

small but courageous faculty. Mr. Joseph E. Sheffield, one of whose daughters was the wife of Professor Porter, had bought the old Medical School Building, had remodeled and added largely to it for the use of the Scientific School; but although his gift put the school in possession of a home, it was still without funds until, in the October following this Agricultural Convention in New Haven, Mr. Sheffield's renewed generosity placed the Scientific School at last on a permanent foundation.

Arrangement of the laboratories had been left largely in the hands of Professor Johnson, who took great pleasure in fitting them up. When finished, with their old-fashioned furnaces and huge sand-baths always warm, they were proudly believed to be, if not the best in this country, at least as good as any on this side of the Atlantic. Mrs. S. W. Johnson preserved the original draft of the following letter. It was laid away with the endorsement, "S. W. J. to Mr. Sheffield on the endowment of his professorship in Yale College."

New Haven, Conn., Oct. 10th, 1860.

Mr. Sheffield;—

Dear Sir, However greatly the country at large may be indebted to your generous liberality in founding the Scientific School on a sure basis, I feel that no individual has more cause of gratitude than myself.

What gratification it has been to me to plan in part and watch the growth of a Laboratory which, thanks to your bounty, is superior to any yet erected for all serious purposes, and not inferior to any in elegance—I can by no means express.

It was another pleasure to be assured that you were ready to equip the new Laboratory with a number of costly instruments, and with such a collection of chemical preparations as would enable it to vie in all respects with other similar institutions in this country.

And now your crowning act of munificence places me in the position to devote nearly my whole energies to the noble science with which in boyhood I resolved to link my fortunes.

Be assured, Dear Sir, that my gratitude, though rather of the silent order verbally, will constantly seek to express itself in faithful labors for the success of the Institution which I hope may shortly bear the name of its honored Patron.

With the highest regard,

Yours truly, Samuel W. Johnson.

The Connecticut State Agricultural Society held a meeting in January 1861, but its activities soon ceased and were not resumed until after the close of the war. Arrangements were made for a second course of agricultural lectures connected with the Scientific School, to be given in February. Rapidly increasing apprehension of war caused these also to be abruptly abandoned, and, in response to the wish of those who had expected to attend them, the regular course on Scientific Agriculture, given in the school by Professor Johnson, was opened to the public. These lectures were designed to cover the whole ground of the relations of science to agriculture.

In the summer of 1861, Professor Johnson undertook a series of observations on the nutrition of plants, the results of which were published in 1866. Reference is made to this investigation in a letter written somewhat later by Dr. Pugh:

I am glad you are about to work at the N question, . . . Your plan will give good results if you can carry it out. 24 pots will make much work, but it will enable you to open the work and have it ready for the *Washington Station*. . . But my dear fellow, get at it. Starve along as best you can, and I will point at you starving when the proper time comes to lay the question of a *Station* before Unele Sam.

In this same year was published Professor Johnson's paper, "On the Soil Analyses of the Geological Surveys of Kentucky and Arkansas," which pointed out some dangers in injudicious application of imperfectly understood scientific principles to practical problems. It was a timely and needed warning to enthusiasts who were ignoring the rudimentary state of scientific agriculture and were attempting the impossible. This publication elicited the following from Dr. Pugh:

Thank you for your paper on soil analysis, it is the right thing in the right place by the right man. I have met some of those Kentucky soil analysts, they did not seem to realize what they were about, your article will show them.

In a letter of later date, Dr. Pugh commented sympathetically on the scheme of agricultural instruction adopted by the Sheffield Scientific School:

I have said enough,—except to express my approbation of your proposed plan to cultivate a few students to a high standard, rather than to popularize many subjects to many people.

Professor Brewer,* at that time first assistant of the Geological Survey of California, wrote from San

* William Henry Brewer grew up on his father's farm in New York State, where he early imbibed a love of agricultural pursuits and acquired

Francisco, on December 20, 1861, asking for advice and assistance in problems arising in his work there, and also said:

I was so delighted to see your article on soil analyses, agricultural survey humbugs, etc., that I began to think agricultural departments of geological surveys were almost useless, until I sobered down and the excitement of your article wore off.

The early part of 1862 passed quietly by, affairs progressing as usual in the Scientific School although the war had paralyzed all outside activities. On February 24, Professor Johnson wrote home:

I am in better health than I remember to have been for 10 years, and have enjoyed the winter weather very much. The war seems to have a good effect on chemistry. The laboratory has 19 students, more by two than we have ever had before. Our funds are all in good condition except some in the Canal R. R. of this State. Mr. Sheffield made good the deficiency out of his own pocket to the amount of \$500, one half came to me. I was a little troubled for a while, fearing that I should be short and behind in rent. I have no other income now of consequence besides my salary, and that is just enough to get along with. All analyses and odd jobs are stopped till the war is over, I suppose. . . .

a taste for natural science. He first went to New Haven to study scientific farming under Professor John Pitkin Norton, with the intention of fitting himself for the life of a farmer. Later, on becoming Norton Professor of Agriculture in the Sheffield Scientific School, he returned to New Haven, where for more than forty years he freely served his university, his city, his state and his country in many forms of public service. His sympathetic and kindly interest in all that appertains to the progress of humanity drew his associates very close to him, and few men in academic life have enjoyed so wide a circle of influence and usefulness.

Reference has already been made to the Morrill Land Bill and its veto by President Buchanan when first passed in 1859. In 1862, this bill, entitled "An Act donating Public Lands to the several States and Territories which may provide Colleges for the benefit of Agriculture and the Mechanic Arts," was again introduced in compliance with many petitions, including one from instructors of the Sheffield Scientific School. It passed both houses in June and was signed by President Lincoln July 2, 1862. Connecticut received under this bill warrants for 180,000 acres of land, a condition of the gift being that the land should be sold and the proceeds invested so that no part of the principal should be expended—and another proviso was that no part of the income should be paid out for buildings. The power of designating the institution to receive this grant was left to the legislature of each state. In Connecticut it was appropriated to the Sheffield Scientific School, which thus became the "Connecticut College of Agriculture and the Mechanic Arts"—the State Legislature in 1863 passing a bill accepting the scrip and devoting the interest to the school. In 1864 a contract was signed between the State of Connecticut and Yale College, providing that the income from funds coming to the State under the Morrill bill from the National Land Grant should be at once, and forever, directed to the enlargement and improvement of the Sheffield Scientific School, with especial reference to agriculture and the mechanic arts. This school was thus the earliest institution actually to use money derived from the National Land Grant.

Dr. George Bailey Loring of Salem, Massachusetts, later United States Commissioner of Agriculture, devoted himself to the promotion of scientific agriculture and to the publication of scientific literature. In September 1863, he asked Professor Johnson to address the Massachusetts Board of Agriculture, saying:

We are obliged to depend on voluntary contributions. I have invited Mr. Harris of the *Genesee Farmer*, Mr. Tucker of the *Country Gentleman*, Prof. Rogers of Boston, Prof. Wyman of Cambridge, Mr. Sanford Howard and Mr. Goodale of Me. to take part in the performances. I think the occasion will be an interesting one, and I trust you will aid us with your presence and counsel.

And so, in December 1863, Professor Johnson lectured before the Massachusetts Board at Springfield, renewing old friendships and forming new ones. His long correspondence with Mr. S. A. Goodale, secretary of the Maine Board of Agriculture, began soon after this meeting. The high personal character and professional ability of the men who responded to this appeal of Dr. Loring's are noteworthy. Nearly all were warm personal friends as well as co-workers for the cause of agricultural science. Professor Johnson took advantage of his opportunity, and in addition to his announced topic, addressed this gathering upon the subject of Agricultural Education.

Collaboration between Professor Johnson and Mr. Goodale of Maine began in 1865 and continued until experiment stations were finally established in this country. Mr. Goodale, an enthusiastic worker for the advancement of scientific knowledge and the author of

numerous valuable treatises on scientific agriculture, wrote, in June 1865:

Your opinion of the Maine Reports is highly gratifying, inasmuch as I fancy you mean what you say, which could not be said of all the flattering remarks which have been made.

He continued:

Your offer to be of service emboldens me to ask if you may not sometime have students who would find good practice in analyzing samples of sup. phos?—and so could have some analysis done at small charge? Perhaps I mentioned before that we have an association of a dozen or so of farmers who have put up a bone mill and make some sup. phos., as yet for their own use, but if the article serves well, propose to furnish others with a reliable article. I have directed the manufacture thus far, and have trials going on in the field of samples made in various methods. . . . If I had the requisite skill, facility and time, would like to analyze these products and compare results with those of the field, and so better judge which—on the whole—is preferable; and it would be something to *know* the chemical composition of what I *know* to be honestly made (if not skilfully), and of good materials.

Mr. Goodale wrote again on November 17, thanking Professor Johnson for analyses received, and said:

I shall be delighted to send you specimens of products and of materials after we get to work—if your assistants want *practice* in analyzing. I don't know how it is with others, but working pro bono publico butters *my* parsnips very lightly—not quite to my taste.

Soon after his own return to this country, in 1855, Professor Johnson suggested Dr. Pugh to the trustees of the Pennsylvania State Agricultural Society as the

best man to place at the head of the new Pennsylvania Agricultural College, and was an intermediary in correspondence on this subject. Mr. Pugh wrote from Göttingen in September and November, 1855:

I saw a student sometime ago as I was traveling in the Hartz mountains, who said he had a friend who spent some time at the Hohenheim School. He said that Prof. Wolff had no reputation at all *there*. He had not more than 1/2 dozen "zuhearers" and these all thought it was "schrecklich langweilig;" he came into the lecture room with an armful of books, and read a little from one and then another, etc. He, this student, said that Prof. Wolff *did not know anything about practical farming!!!*—that he only had some *impractical theoretical* views of his own that every farmer knew were of no practical value etc, etc. Don't think that since hearing the above I have burned my "Naturgesetzlicher Grundlagen des Ackerbaus," I merely wanted to remind you that when such men as Dr. Wolff are thus unsuccessful, when stupidity and ignorance obstruct their progress, younger hands need not lose *confidence in themselves* if they don't meet with universal success in the same field. . . . The student whom I met in the Hartz was one who had been a "Nachmittage Practicant" in Erdmann's Lab. the first winter I was in Leipsic and not a very industrious one. . . . He was managing a farm in the neighborhood—had not studied chemistry any since that winter and yet thought he knew enough for a practical agriculturist, without any advice from such men as Prof. Wolff, etc., etc. . . . With regard to the Penn. Ag. School, I would be willing to accept the position of Principal in the School. Indeed I would take it *gladly* at the end of 2 years, it would enable me to make different arrangements before leaving Europe than I otherwise could make. . . . You can read my letter to Dr. Elwyn. I don't doubt but that if one got into a place where the arrangements were not the best in the world for the promotion of ag. science he might *bend* matters grad-

ually into a proper course. . . . Many thanks to you for your kindness in noticing me to Dr. Elwyn. I hope I may yet live to return you the favor in some way.

As the result of a proposition made to him by Mr. J. B. Lawes of Rothamsted, England, in 1857, Dr. Pugh undertook a new investigation of the question at that time so vigorously debated in France between Boussingault and Ville, as to the assimilability of free nitrogen by plants. This work occupied two years, and seemingly conclusive results were reached which showed the assertions of Ville to be unfounded. Most interesting is Dr. Pugh's description, in a letter to Professor Johnson, of the Rothamsted Laboratory, then the only place in the world where so costly an investigation could have found such generous support.

Harpenden, Herts, Aug. 2nd, /57.

My dear Johnson,—The contemplation of a train of past events carried my mind back, this morning, to the time that I broke in upon your meditations for the first time at No. 1678 West Strasse. . . . With no part of my course am I better pleased than with that upon this Anglo-Saxon sand heap. But as you are a student of Liebig, it would hardly be safe to say much in favor of this antipodal climate. You will see at the head of my letter a picture of my present laboratory. It was built at a cost of 1000£ by the farmers of England as a testimonial to Mr. Lawes. They gave him his choice, a *Laboratory* or its value of *Plate*. His choice speaks for the man quite as much as do *libelous* statements about his *motives*, and he now expends from 1000 to 1500£ a year in making investigations that have no more bearing upon his super-phosphate manure than they have upon a mountain in the moon. There are perhaps people who, incapable of a generous

act themselves, might find a mercenary motive in his sustaining a school at his own expense for 200 poor children in London, or for his offering the cottagers of this village 600£ to improve their cottages with so soon as they raised 1/2 that sum, or for his building them a library to try and elevate the condition of the laboring men. . . .

They have supplied me with about \$500. worth of apparatus, and we have been doing up the subject on a scale unprecedented. I have 12 glass shades 3 1/2 ft. high and 9 1/2 inches in diameter, and under them, entirely isolated from the air, we are growing plants and forcing NH_3 -free air into them daily. Day before yesterday we had a visit from Prof. Graham, Noad (author of analysis), Bolard (French) and 5 or 6 others. Our results indicate a confirmation of Bous-singault. The evidence accumulates. . . . I asked Bolard how he accounted for Ville's plants growing as they did. He answered "*Il a ajouté sans doute.*" He said nobody in Paris trusted them. Indeed I have not yet decided whether to treat Ville as though he didn't exist (silent contempt) or to expose him. Boussingault said in a letter the other day to Dr. Gilbert "from my own experiments I am fully persuaded that plants don't assimilate N, yet," continued he, "so great is my confidence in the Rothamsted experiments that should you get an appreciable increase of N, I shall modify my views." . . . Yours most truly, E. Pugh.

In the fall of 1859, urged by a patriotic sense of duty, Evan Pugh accepted the presidency of the Pennsylvania State Agricultural College and returned to America, where he employed his talents and his knowledge in establishing his college on a broad and enduring basis; with such success that at the time of his early death in 1864, he was recognized as one of the most able of the men then engaged in the advocacy of scientific agricultural education in this country.

Extracts from his letters to Professor Johnson during this period give an outline of his work in Pennsylvania.

(E. P. to S. W. J.)

[October 1859] . . . On the 3rd of last August . . . one and a half hours before starting [*for America*] I received a telegraphic message informing me that the Penn. Ag. College had sent me 800 dollars to purchase apparatus with. I then left Liverpool for London, then to . . . Dresden (saw Stoeckhardt, who wished to be remembered to you, and also those experiments with plants in water). Chemnitz (Dr. Wunder sends his Grüse) Leipsie (Grüse von Erdmann). . . . Cirencester (saw Voeleker, he thinks your summary in Silliman's Journal is good as also does Stoeckhardt—it certainly is, too). And finally left for New York . . . after a few days came on here and saw Judge Watts, the President of the Board of trustees of Penn. Ag. College. . . . I took tea yesterday evening with Dr. Elwyn. He says you have just published something on the American Phosphates, I wish to see it—Can't you send it? . . .

By the way, what about $O = 8$ or $O = 16$? The English chemists are drifting into $O = 16$, and Kopp told me that he had a great mind to come to it himself, as it was best, and he was only prevented by the trouble involved in making the experiment. I am studying about whether I had better not commence here with $O = 16$.

I am not sure that our ambition, as indicated in our catalogue to which you refer,—to develop upon the soil of Penna. *the best Ag. College in the world for the ag. student of America*—would not require an apology to such a venerable Institution as Yale with its history of half centuries looking down upon us, and the concentrated energy of its ripened vigour now devoted to the establishment of an ag. school. . . . I have been too busy to get to Washington, but I hope I yet may do so. . . . We are doing all in our power to move our

own legislature to \$40,000 and until we get a little more done at home, I fear I shall have to be busy here. . . .

[1860] Why were you not at the Association? I wanted to gossip with you about a plan for making a series of experiments on ag. practice with manures and a project for getting 10 or 15000 dollars from Congress to do it with, etc. etc. . . .

We here, with imperfect organization, over head and ears in debt, with buildings half finished and only 100 students, have *consumed* annually about \$400 worth of apparatus and reagents—no purely literary man could see the use of all that expenditure, and hence it could not be made through him. I found Dr. Voelcker at Cirencester, calling on a parson president to approve of a change in the *structure of a sand bath!!*—and Dr. Schultz in Berlin working an agl. class in a garret because the great University had too many uses for its money to give him more room!!!—Hohenheim, and Popelsdorf and Tharandt owe most of their efficiency to their standing alone. . . .

[1862] The Washington folks are still talking about the Agl. Dept. and writing to me about it. I laid out a plan for them that will take \$100,000 to start upon. I don't expect they will get more done than talk this winter. The bill as reported, is a humbug, but it may be made something of yet. I shall say more about this again. The agl. dept. is doing nothing and I fear it will fizzle out if something is not done. . . . It is a scientific and not a practical man that is wanted there.

[1864] We have had a long hard fight on the Land Grant Fund—we have outflanked the enemy and spiked all his guns, but the infernal guerrillas still hover around in the shape of anonymous correspondents, etc. I still have some fears, though they are very much allayed.

Professor F. H. Storer occupied in Massachusetts a position analogous in many ways to that held in Connecticut by Professor Johnson. On the founding, in

1870, of the Bussey Institution of Harvard University—referred to at the time as “the nearest thing we in Massachusetts have to the experiment station, and capable if rightly handled of doing great good”—Professor Storer became its dean, as well as professor of agricultural chemistry in Harvard University. He held many tastes and sympathies in common with Professor Johnson. When the letter following was written, he was engaged in the general practice of his profession in Boston.

(S. W. J. to F. H. S.)

New Haven, Conn., June 5th, 1860.

My dear Storer,—I am much obliged to you for your good offices in the coal tar line. I should like specimens of pretty good size of the various products viz., of “naptha,” “carboline” and “dead-oil,” two gallons or more, up to 5 gals. of each. A chunk of pitch “as big as a piece of chalk” would be very acceptable as a sample. As to naphthaline, I leave the quantity to your discretion as I have not the slightest idea how large the yield is, or how much could be “run off” “just as easily as not.”

I would be glad to get a few ounces; but would not refuse it pound-wise. The main point is not to abuse the generosity of your friend. Of that you can judge. Don’t be afraid to make the quantities smaller, down to any minimum, if you think those I have mentioned are too steep!

Brush desires you to give his remembrances to Warren,—also express to him my thanks for his kindness in rendering us such service.

I neglected to invite you to call at 95 Wall and stay with me whenever you are in New Haven. Do so by all means, and I hope when I see you next I shall have some comfortable amount of *vim* in me. Yours with thanks, S. W. Johnson.

Control of insect life injurious to vegetation is now understood and practiced to a very considerable extent, and much precise information has been collected in regard to it. The state of knowledge of this subject in 1863 is reflected in this letter from Professor Storer:

My dear Johnson,—I wish you would take the trouble to look at a note by Letellier in *Comptes Rendus*, 1837, IV, 255, on the destruction of insects (without detriment to plants) by means of an impure alkaline cyanide prepared by calcining animal matters with lime or potash; and tell me whether the idea has amounted to anything in practice. Experiments go to show that plants are not easily hurt by the cyanides, do they not? If this be true it would seem as if the thing might readily be carried out in connection with that system of cooking old shoes, woolen rags, etc. in order to activate their nitrogen, which was so much in vogue in Germany a few years since.

That running riot of army-worms, etc., to say nothing of our old Saxon friends the Maikäfer, always aggravated me consumedly, and it does seem weak that we can't circumvent the scoundrels. N. B. The National Academy may like to stick themselves in the mud by attempting to solve the above question of circumvention? We shall have some gay and festive generalizations when the Museum of Comp. Zoology comes foul of investigations of this sort. Yrs. F. H. S.

In the letter following, Professor Storer recorded some of the current chemical talk of the day:

Boston, Jan. 10, 1864.

Dear Johnson,—Yours of the 24th ult. came to hand a day or two since, "Frank S." being unknown to the contemned fool at our P. O. You know well enough how the Prophet

suffers in the place of his nativity and will experience no surprise. There is, however, just a shade of queerness in the fact that when Brush [*as*] of old directs to me in N. Y. the letter reaches my father's door quicker than the one which you sent straight to Boston.

Egad old fellow, I should think your stomach *would* ache with a dozen of letters, or less, from one chap sticking therein. However! I'm not specially exigent and am ready enough to forgive sins of omission at any time. Your name was honorably mentioned as an undoubted authority in the matter of scientific education, by Prof. Woodman at the Institute of Technology the other night. Woodman made *several* sensible remarks on that occasion.

There is little or nothing *los* hereabouts. Warren (and Storer) are working like beavers—being in a position, if ever men were, to realize the length of art and brevity of life. With myself this is simple task work—my mind being well nigh blank.

J. Wyman's experiments on spout. gen. have stirred up the very liveliest kind of a fight in France—perhaps you have followed it, as I have with a good deal of interest, in *Le Courrier des Sciences*. I am very anxious that Wyman shall publish his *thoughts* and views on this subject,—'twill then ascend from its present level quickly enough, I can assure you. And this no matter whether the dogma itself (immaculate conception!) be right or wrong.

By the way, was your lecture on "fermentation" written out? If so, pray lend me the loan of it. I have just been reading a lecture upon this subject by my friend Lieben (late of Vienna, now of Palermo, Naples or Pisa) and am very curious to see how your several minds have worked. For a German lecture, Lieben's is excellent.

Eliot is in a pension way up outside of the Arch of Triumph—over to the left as you go out towards the Bois. In the same house boards a Prof. at one of the Lycées, who has put E. through all the lower educational sprouts in famous

style. Eliot is in the highest possible spirits, and is studying the French system of education *con amore*—root and branch. He writes that chemical thoughts have no chance of getting near him at present. 'Tis really jolly to read how new sensations are buffeting the hay from all quarters. It makes me feel, though, almost as the Childe Harold did after he had soared his swing.

E. is fortunate in arriving just as a new minister of instruction is ventilating all the dry bones; he says that the newspapers and journals are filled with discussions concerning the new measures. . . . Yours ever truly, Frank H. Storer.

In September 1866, Professor Storer answered various questions concerning materials and methods of analysis:

I have been intending to inform my mind about those peat firms for a long while, so that your spur touches effectively. . . . Eliot will be equally glad with myself to see the light of your countenance. We are gay and festive in spite of undue friction.

Late in the year he wrote:

Accept my love! I reproach myself with the thought that I failed to write to you last spring the address of an artificer in glass—so ein rechter, vornehmer reicher (not a mere blower), who much desires chemical custom. . . . He is an independent tinker who goeth about where he listeth, buying molten glass in the pots of various works and fashioning his goods then and there. I think him capable of making the "H₂SO₄ dryer" which was so near your heart in the days of lang syne.

This "H₂SO₄ dryer" was a piece of apparatus early devised by Professor Johnson and fondly cherished in imagination for many years. It assumed corporate form about 1889, when in his "Report of Director"

of the Connecticut Agricultural Experiment Station, Professor Johnson described the "Gas Desiccator" which he then had recently had made by Greiner in New York for use in the station laboratory.

The spirit of the new scientific education, so distrusted by conservative classical scholars, had been gradually winning a way in American college circles—largely because of the personality and tolerant attitude of some of its foremost advocates. In 1869, Harvard University took an almost unprecedented step forward by choosing a layman and a chemist to be its official head. Whether this action, which ranged the University uncompromisingly on the side of educational progress, was regarded as a victory or as an experiment depended upon the vision of the beholder—men of science in America united in acclaiming it the beginning of better days. The letter of felicitation, written in the spirit of prophecy and from a full heart, which Professor Johnson sent to President-elect Eliot, has not been preserved. In acknowledging it, President Eliot said:

A victory implies that some one is defeated. That is not the true aspect of my election. It is simply an experiment, made by the governing board of the University in a spirit truly scientific, I think. The greater part of the crowning will have to be reserved for the issue from the woods ten or fifteen years hence. As you say, the first and best thing to be done is to show that letters and science are not mortal enemies but helpful friends. . . . "Vision and strength"—that is well said—that is just exactly what is needed. Take care of your stomach and reserve yourself for the good days to come.

During the years beginning with 1864 and ending with 1870, Professor Johnson wrote three books. "Peat and its Uses as Fertilizer and Fuel" grew out of work begun in the interests of the Connecticut Agricultural Society. Published in 1866, this book was, in 1910, referred to in the columns of a leading agricultural journal as still true and useful, containing all that could today be said on the subject, the writer regretting because of this fact that it is now out of print.

Professor Johnson had devoted the best powers of his mind to collecting and arranging the conflicting evidence on record in the literature. Therefore he could teach his subject with such certainty as the true state of knowledge permitted. The results of his studies were set forth in the two volumes, "How Crops Grow" and "How Crops Feed."

"How Crops Grow. A Treatise on the Chemical Composition, Structure and Life of the Plant, for all Students of Agriculture," which was published in 1868, has been perhaps more widely read and studied than any other work on agricultural chemistry. It gave a new basis for the teaching of agriculture as well as a broader understanding of the principles and the reasons of farm practice. In his preface the author said:

Agricultural Chemistry has ceased to be the monopoly of speculative minds and is well based on a foundation of hard work in the study of facts and first principles. Vegetable Physiology has likewise made remarkable advances, has disencumbered itself of many useless accumulations and has achieved much that is of direct bearing on the art of cultivation.

“How Crops Feed. A Treatise on the Atmosphere and the Soil as related to the Nutrition of Agricultural Plants” was published in 1870. Professor Johnson’s object as stated by himself at the time was to “digest the cumbrous mass of evidence in which the truths of vegetable nutrition lie buried out of the reach of the ordinary inquirer, and to set them forth in proper order and in plain dress for their legitimate and sober uses.” He did not seek “to excite the imagination with high-wrought pictures of overflowing fertility as the immediate result of scientific discussion or experiment,” nor did he attempt “to make a show of revolutionizing his subject by bold or striking speculations.” This was characteristic of the man. It was his cool, judicial weighing of the evidence and presentation of results in a clear, dispassionate way that gave these two books their value and commended them to students of agriculture. They were the beginning of a new and better agricultural literature, and yet their author felt impelled to say:

It is a source of deep and continual regret to the writer that his efforts in the field of agriculture have been mostly confined to editing and communicating the results of the labor of others. He will not call it a misfortune that other duties of life and of his professional position have fully employed his energies, but the fact is his apology for being a middleman and not a producer of the priceless commodities of science. He hopes yet that circumstances may put it in his power to give his undivided attention to the experimental solution of numerous problems which now perplex both the philosopher and the farmer; and he would earnestly invite young men reared in familiarity with the occupations of the farm, who are conscious of the power of investigation, to enter

the fields of Agricultural Science, now white with a harvest for which the reapers are all too few.

A few letters written to Professor Johnson in connection with "The Crops," as they were familiarly called, are given a place here:

(J. B. L. to S. W. J.)

Rothamsted, St. Albans,

February 3, '70.

Dear Sir,—On calling at the Agricultural Societies' Rooms at Hannover Square this week, I received a copy of your book "How Crops Grow." How long it has been there I do not know, but I hasten to thank you for it, and I have so far gone over its contents as to satisfy me that it is by far the best summary of information in this subject which has yet been published. . . . Believe me, Yours truly, J. B. Lawes.

(G. C. C. to S. W. J.)

Ithaca, April 7th, 1870.

My dear Johnson,—I received a few days ago, a copy of "How Crops Feed." It is of course good—excellent—It explores the ground gone over so thoroughly, in fact, that, if introduced as a text book, you haven't left much for a fellow to lecture about. It came just in time for me to begin with it next term, in my class in Agricultural Chemistry, and I shall use it, even though it leaves me no opportunity to display my own wisdom.

Your reference to my book in the Preface to "Fresenius" is very kind, as well as the notice in the *American Journal*. . . .

How the ranks of Agricultural Chemists in this country are enlarging. Goessmann at Amherst and Goodale in Maine are valuable accessions. Yours sincerely, G. C. Caldwell.

(J. H. G. to S. W. J.)

Harpenden, St. Albans,

Mar. 25, 1871.

Dear Sir; On behalf of Mr. Lawes, to whom you were good enough to send a copy of your very compendious work entitled "How Crops Feed," I have to beg that you will accept his best thanks. The book has indeed proved to be of particular interest to Mr. Lawes, embodying as it does so much of the results of investigations made in Germany and not otherwise recorded in the English language.

I see that we have sent you some of our own publications from time to time, but so far as our records go by no means the whole of them. I send you by this post *Tables of Contents* printed for binding up with our papers, and Mr. Lawes begs me to say that if you will let us know which you do not possess, he will have pleasure in making your set complete so far as he is able.

I am, dear sir, Yours sincerely, J. H. Gilbert.

(H. v. L. to S. W. J.)

Sehr geehrter Herr Dr.

Ich bin Landwirth und Chemiker und habe mich seit den letzten Jahren ausschliesslich mit Chemie beschäftigt. Mein Vater gab mir Ihr Werk und wir stimmen darin überein dass es ein sehr gutes Handbuch für Landwirthe ist, und sich auch in Deutschland viele Freunde erwerben würde. Mein Vater hat Herren Vieweg aufgefordert eine Uebersetzung machen zu lassen, die dieser mir übertragen hat. Ich wollte Sie nun vorher bitten mir Ihre gütige Erlaubniss dazu zu ertheilen und etwaige Wünsche mich wissen zu lassen bevor ich an die Uebersetzung gehe. Es wird nur sehr wenig für deutsche Verhältnisse zu ändern sein und diese höchstens in Auslassungen bestehen die nur für Amerika Intresse haben, da es ja

fast ganz auf deutscher Grundlage fusst. Mein Vater lässt Sie bestens grüssen. In der Erwartung einer baldigen Antwort bin ich mit

ausgezeichneter Hochachtung

Ihr ganz ergebenster

H. von Liebig.

München den 29 Nov. 1869.

(H. v. L. to S. W. J.)

Sehr geehrter Herr Professor

Erst jetzt ist endlich, der erste Theil gedrückt und ich hoffe Sie haben durch Westermann einige Exemplare erhalten. Ich hoffe, dass es denselben Anklang in Deutschland finden wird wie bei Ihnen, den das Buch mit Recht verdient. Der 2ter Band ist auch bereits seit Wochen fertig aber Vieweg hat den Druck noch nicht begonnen, was mir sehr unangenehm ist. Ich habe grade in diesem Theile in manchen Kapiteln grössere Zusätze machen müssen, indem ich grade als Practiker aus eigner Erfahrung, manches was mir von grösserem Gewicht schien mehr zu betonen, und auch etwas näher noch von anderer Seite zu beleuchten, ohne dess wegen Ihre Ansichten zu bekämpfen—wie Sie dies schon aus der Behandlung des ersten Bandes in den Anmerkungen ersehen. Es wäre mir angenehm, wenn Sie sich darüber gegen mich aussprechen, ob Sie mit der Uebersetzung zufrieden sind, oder was immer Sie für Wünsche haben, damit ich mich danach richten kann. Ich habe Ihnen gleichzeitig eine Arbeit über Bodenanalysen beigelegt, die wie ich glaube von einiger Bedeutung gerade für die Praxis sein dürften. Ihr Buch ist nicht blos für Schüler geschrieben sondern bietet auch dem Agriculturchemiker von Fach eine Fülle vom Aufgaben die sich ihm erschliessen, wenn er wie hier die Arbeiten Andrer im Zusammenhang betrachtet. Ich selbst habe vieles

aus dem Buch gelernt. Wie man denn auch aus Mängel bei angestellten Versuchen erst auf das bessere gelenkt wird. Ich freue mich schon wieder etwas aus Ihrer Feder geflossenes zu lesen und bewundere die Gabe wie Sie den Stoffe zu ordnen und zu behandeln verstehen, was der höchste Aufgabe des Lehrers ja ist.

Indem ich mich Ihnen bestens empfehle bin ich mit grösster Verehrung und freundschaftlichster Hochachtung

Ihr ergebenster

H. von Liebig.

München den 6 Juni 1871.

Here are some family letters:

(S. W. J. to A. A. J.)

New Haven, Conn., Sept. 3d, 1860.

Dear Father,—Pony and I arrived here safely on Friday. . . . I find that the cost of keeping is \$4.00 per week (Hay \$20 per ton), but I think I shall make money out of him in health at that.

I found the house in good order, only the garden was buried in grass and weeds, but I shall shortly make a scattering among them.

The new Laboratory is progressing finely and a fine affair it is going to be.

I doubt not that I shall be credited with a grateful spirit towards those whose kindness has put Pony with his appurtenances in my possession, but I desire to place here on record my acknowledgments to my excellent Parents for this gift which I trust will prove a great blessing to me, and in this my precious wife fully unites. May God richly reward you, dear Father and Mother, for all the numberless acts of kindness which you have never ceased to perform toward—Your affectionate Son,

Samuel.

(S. W. J. TO A. A. J. AND A. W. J.)

February 1861.

Dear Father and Mother,—Not infrequently I think and say I must write home, but not being one of the sort that can always do everything and having about as much to do as I can well get along with, I don't write very often. . . . I feel very much as one might imagine that ancient military man, Capt. Sisera did when the tender-hearted Jewess drove a 75-penny nail in his head.

I am now lecturing 5 days per week on Ag. Chemistry, which keeps me pretty busy. . . .

Pony is a great Institution. I have ridden him pretty steadily when the weather has admitted, and sometimes when it didn't. I find his jolting, which I am now accustomed to, is an excellent back-bone stiffener and brain-clarifier. The animal himself is so full of notions, mostly good, that it is a perpetual feast to take him out. I often ride with a friend, a young clergyman who is good company and mounts a good horse, and we can get over the ground quite rapidly when we attempt it. . . . We have several macadamized or oyster-shell roads that are always hard even in the wettest weather. The long-expected endowment has come at last, and with it I have half the day to myself, and thus have time for exercise. . . . But I am at the end of the sheet, and have only room to inquire about your health and send the love of

Lizzie and Samuel.

The autumn of 1862 brought a variety of conflicting emotions into the large family circle, which up to this time had remained unbroken. An Indian uprising in Minnesota caused anxiety on behalf of the loved ones there. In a letter of September 22, Mr. Abner A. Johnson wrote:

The twins had a letter from Sarah yester-morn, giving some account of the Indian war panic, the arrival of Jason from

Winnebago City in about 24 hours or less (100 miles or over), and soon several others who at present stop with Sarah, making quite a house full. Jason went to Preston and raised over 100 men and some munitions of war, and went on to protect the inhabitants from massacre. We anxiously wait to hear from him. It is stated that there is a treaty being made with them, or a part. These are troublous times. We will hope for the best. Until within two years everything went smoothly on, as a nation we knew little of troubles like the present. The rebels seem hard to conquer, or our military leaders are greatly deficient in skill or loyalty.

The times were indeed troublous, yet father and son rejoiced together over the birth of a child.

(S. W. J. to A. A. J.)

New Haven, Conn. Oct. 4—1862.

Dear Father,—Yesterday our Elizabeth Annah, daughter of Samuel and Elizabeth, arrived safely at the age of one fortnight. She is named by her mother after my wife and mother. Last night as she was weighed, we thought it rather strange that her Uncle Abner and Aunt Annah had not signified by any word that has reached us, their approval of this newest grandchild. It being not impossible in these troublous times that the mail miscarried, I hereby make avowal of the advent of the little angel and call upon all concerned to rejoice. It is very true she is born into a pitiful world of discomfort, and inherits more weakness of body and soul than it is comforting to think upon. Yet this birth may not unlikely prove to her the blessed event it has always been to those who make it the point of setting out in a life that harmonizes as well as in its infirmity it may, with the great life of God.

Libby has written to Mother about staying here with us through the winter, or until Jan. I much desire her to remain

for the sake of Lizzie, who I doubt not owes very much of her health and comfort to her society, and not less for her own benefit. If, however, Mother needs her or only strongly desires her presence at home, I am sure both Libby and Lizzie, and myself not less, hold our Mother's claims in every way paramount. . . .

I am nearly resolved to dispose of Pony, either entirely or for the winter,—\$200 a year is more than I can well spend on him, since, in the present depression of business, I have few odd jobs or little to rely upon besides my salary. What had I best do? . . .

Behold how long a letter I have written with my own hand!
Affectionately,—with love to all, Samuel W. Johnson.

(A. A. J. to S. W. J.)

Deer River, Oct. 7th, 1862.

Dear Son,—Yours of 4th inst. I just received while at the P. O. to hear the war news (which by the bye, was not much). We congratulate you and Lizzie on the birth of your little angel daughter, and rejoice none the less because we have not written to say we rejoice. May a kind Providence bless the little stranger and parents too, and enable you to “train her up in the nurture and admonition of the Lord” that she may be an angel indeed, whether her stay on earth be longer or shorter. It is our desire and prayer to our common Father daily that our children, and theirs, may wisely use the time given them in laying up a treasure in Heaven and so fulfill the great end for which they have a being here. While you rejoice in the gift you doubtless will feel the responsibility resting upon you in consequence of the gift, as well as all the other gifts your kind Benefactor has bestowed upon you. . . .

Libbie can do as she likes about staying. Lizzie wrote to your mother for her assent to name her little granddaughter after her and her own mother. She assents cheerfully to her wishes. As to Pony, you can better judge than I, as yet the

war taxes have not been hard. How heavily they will come upon us, we do not yet know—but they will be heavy there is no doubt. In addition to all other taxes, this town voted at a special town meeting to borrow \$4000 for bounties for volunteers, which amt. has been loaned and the tax must be levied.

We have heard nothing very recently from Jason or Sarah. The Indian troubles are rather subsided, as the papers say. Love to all. Your affectionate father, A. A. Johnson.

In October, an epidemic of typhoid fever had started in the village of Lowville. At the beginning its nature was not recognized, and Esther Johnson, wife of Giles C. Easton, was one of the early victims. Her death, the first among eight brothers and sisters, was peculiarly sad, as it left two little children motherless.

(S. W. J. TO A. A. J.)

Nov. 22—1862.

Dear Father,—I expected to see Giles and did not write. Why he has not been here, and why we have not heard a word from home, is a thing we don't understand. . . .

How is Giles,—and the pestilence at Lowville? How are the little motherless Hatty and Abner? Poor children, how my heart ached for them. Above all, how is Mother since the Winter began?

We all send love—

(A. A. J. TO S. W. J. AND E. E. J.)

Deer River, Deer. 25th, 1862.

Dear Samuel and Lizzie,—I wish you and your little daughter a Merry Christmas. . . . Esther's children are with us, and tho' it adds much to the care and labor of your mother and sisters it is done cheerfully. I trust they will receive their reward.

I am glad that all our children are so good. God bless them. May they all continue to be respectable and useful. I wish I were able to place them all in circumstances of competence as to this world's goods, believing most of them have chosen the good part never to be taken from them. . . . Our best love and good will to you three. Your Mother's health is nearly as good as it has been for years, so far as I can see. Affectionately,

A. A. Johnson.

Early in 1864 came another family bereavement, the death of Mrs. Abner A. Johnson. In January 1866, Professor Johnson wrote to the home at Deer River, where his three youngest sisters were caring for their father in his old age:

Dear Lizzie, . . . You may or may not have heard of the National Academy of Sciences, composed of 50 scientific men who are or ought to be foremost in their respective departments. Well, that body has just held a meeting at Washington, and has elected me a member. I presume you (I write to Father and all the family as well as you, and mean them by "*you*") will think full as much of this honor as I do, which is not a great deal, still you know that "straws show which way the wind blows."

I have subscribed for a new magazine (English) called the *Argosy*. I shall send the numbers to you—the three sisters—to read and keep. It begins very well, and you will find it full of good reading if it continues as good as it has commenced. . . . Affectionately—if rarely on paper—Your brother,

Samuel W. Johnson.

In connection with his election at the early age of thirty-six to membership in the National Academy, it may be noted that Professor Johnson possessed one of the attributes of a great teacher, the discriminating ability to discern and to set forth clearly the basic

truths of science. He was, in his own day, a master of the theory of his profession in so far as it had then been developed, and his skill in rendering useful to practice the scientific and theoretical work of others, together with his ability personally to contribute to the sum of such work, was the foundation of his usefulness in the early days of agricultural science in this country.

Although Mr. Abner A. Johnson's strength was rapidly declining, his house remained a center of hospitality. Mrs. S. W. Johnson, writing to her husband from Deer River in September of this year, told of the entertainment of old friends. She added:

Father put on his best coat and met them at the dinner table—most hospitably he received them, nice old gentleman that he is! I have always admired your unfailing kindness and courtesy to our visitors, and I see now you always had a good example.

Few more letters were written either to or from the Deer River home, which was broken up the following April, immediately after the death of its builder.

CHAPTER VI

CONNECTICUT STATE BOARD OF AGRICULTURE

The first faculty of the Sheffield Scientific School was regarded in academic circles as a band of radical enthusiasts; the action of the governing board of the school in permitting its members to give a part of their time to public service was an innovation not approved by conservatives who held that extra-curriculum activity was rather unprofessional; but in spite of the disapprobation of those who felt that a college professor should confine himself strictly to pedagogical duties, Professor Johnson and his colleagues had always carried on along with their classroom work a larger work in the education of the public. This they did on the lecture platform, in the public press, and by means of personal influence exerted through a wide acquaintance with many kinds of men; and the governing board of the school, sanctioning their activity, enabled them thus to set forth "a forceful illustration of the power which a scientific man can wield for the good of the community."

The Connecticut State Board of Agriculture, formed in August 1866, continued and extended the work of the old Agricultural Society; the Sheffield Scientific School, in its annual report for 1866-67, which says "The officers of the school refer with pleasure to their relations with the State Board of Agriculture," maintained the cordial attitude of the old "School of

Applied Chemistry" towards scientific agriculture. Professor Johnson took an active part in the organization of the Board, and at its first annual meeting, held in Sheffield Hall, New Haven, he delivered two lectures; the one, "Recent Investigations concerning the Source and Supply of Nitrogen to Crops," the other, "The Principles which may Guide the Farmer in the Selection and Use of Fertilizers." On January 13, 1869, he again lectured before the Board of Agriculture, talking on the "Nutritive Value of Grasses and Green Fodder, as indicated by Chemical Analysis and Feeding Trials."

His "Report on Commercial Fertilizers," made to the Connecticut Board of Agriculture on April 10, 1869, marked the formal resumption, under official sanction of this Board, of work done in connection with the Agricultural Society during 1856 and succeeding years. In it were incorporated the results of sixteen analyses of fertilizers, the analytical details of which were performed by Mr. W. O. Atwater, who at that time was studying under Professor Johnson's direction in the Sheffield Scientific School and was also acting as Professor Johnson's private assistant; later he became a prominent worker in similar lines of research. This report attracted attention outside of Connecticut. In November the Commissioner of Agriculture at Washington said in a letter to Professor Johnson:

A floating paragraph states that you have been engaged in analysing numerous samples of commercial fertilizers. If such be the case, I would be glad to have you furnish in some detail the result of the investigation for the use of this Department.

Professor George H. Cook of Rutgers College wrote from the office of the State Geological Survey, on September 18, 1869, commenting with approval on the report, and saying:

Your straightforward estimate of the value of different fertilizers is producing a sensation among both manufacturers and consumers,—and will be of great service to Agriculture.

He closed his letter with this sentence:

The circulation of such reports as that of yours *on fertilizers* will be of great use, and I hope you will be allowed to continue making full and fearless reports on the worthless manures which are so common in market.

Professor Johnson had altered and improved the text of "How Crops Feed" almost up to the moment of stereotyping the pages; when its publication relieved this strain, he found that nerve exhaustion complicated the malaria with which he had suffered for several years. A camping trip in the Adirondacks improved his apparent condition, and he returned in the fall of 1870 to his college duties, lightened to some extent, as he was now relieved from daily superintendence of the analytical laboratory. He wrote on September 20:

The Laboratory is getting on nicely with Allen at the head. I have five exercises weekly (2 ag. chem. and 2 analyt. chem.) coming at 10 o'clock each weekday except Friday. I am now ready, all except health, to renew the text-book work. O! I would that it were off my hands!

During the winter he refrained from all save classroom work, but notwithstanding careful living and the

relinquishment of outside activities his health was not fully restored.

In 1872, the time seeming to have arrived when organized effort for the establishment of experiment stations in this country might meet with success, Professor Johnson, in addition to giving his regular courses of lectures and recitations in the Sheffield Scientific School, devoted much strength to the systematic agitation of that matter, so near to his heart. A national agricultural convention was held in February at the Agricultural Bureau in Washington, on call from the Commissioner of Agriculture; among the hundred or more delegates were Professor Gilman and Professor Johnson, representing the Sheffield Scientific School. Professor Johnson wrote home from Washington on February 15, 1872:

Came in yesterday with a jolly company. Pres'd't Clark of Amherst, Mr. Goodale, Mr. Gold, Gov. Hyde, etc. etc.,—arrived here safely at 5 P.M. Found the hotels crammed and jammed, but by heavy play on dignity got a good 5 story room and now at 8 A.M. shall br'kfast after writing you a line or two more, and then to Uncle Frederick Watts. Gen'l Eaton invited me to dinner this evening. Shall go of course.

This agricultural convention was effective in placing the experiment station movement before the people as a question of national policy, and the publicity given to its discussions aroused a wider interest in the matter. From far and near came letters asking Professor Johnson for advice as to methods to be pursued to gain the best results—how should legislation be framed to secure an institution suited to the needs of our people? Late in the year he was appealed to by President Clark

of Amherst for information as to the "usefulness as shown by any specific valuable results of the experiment stations of Europe," and in January 1873, President Clark wrote:

Please accept thanks for the valuable information this day received. It is just what I desired. Let us rejoice together over the prospect of the passage of Mr. Morrill's bill. You will of course attend the Convention at Washington which we have called Feb. 27th, one week later than was intended when we adjourned last year.

In September 1872, Mr. A. B. Crandell, agricultural editor of the New York *Tribune*, wrote, stating that the large agricultural correspondence of that paper contained frequent queries of a chemical nature. He asked permission to refer such letters to Professor Johnson for answer, the replies to be published in the weekly and semi-weekly issues of the *Tribune* over signature, and in closing, said:

It is not probable that there will be enough of them to render the duty at all burdensome.

In November of the same year Mr. Crandell asked—in addition to replies to three letters enclosed—for a half-column article regarding the effects of lime on hill pastures, and went on to say:

We shall also—if the terms named are satisfactory—be glad to have an occasional paper on any subject you may think worth while to discuss.

From the first, the essays and discussions that appeared over Professor Johnson's name in the *Tribune* attracted attention; in a year's time the volume of his correspondence upon chemical points had so

increased as to falsify Mr. Crandell's prediction. Still, appreciating that this newspaper correspondence had developed into a unique opportunity for missionary activity and was of educational importance, reaching as it did a national audience through the *Tribune* columns, Professor Johnson kept on with it, loth at heart to relinquish writing although he realized that long-continued strain was telling on him. While his mental industry was incessant, he was constitutionally incapable of turning off work hastily. Not only must his knowledge of the point involved be exhaustive and accurate, but each paragraph, even if of minor importance, was rewritten many times before it was parted with; when finally sent off it was as clear as it could well be made, representing the best he could do with the subject, and bore little trace of the concentrated effort that left its mark on the author.

Professor Johnson had set forth in his report on commercial fertilizers, made to the Connecticut Board of Agriculture in June 1870, the then existing conditions of the applications of science to agriculture. His opening sentence referred to his own first exposition in this country of principles, worked out at the German Versuch-Stationen, which he hoped would before long be brought into practical use in American experiment stations.* He then discussed the whole subject of the analysis and valuation of fertilizers, referring for methods and standards to his "Reports" made in 1857, and in 1858, to the Agricultural Society, and describing the current practices of the German experiment stations, of the English and Scotch agricultural

* See page 107.

societies, and of the Rothamsted Laboratory, which was then the private philanthropy of Mr. (afterward Sir) John Bennett Lawes, the earliest English manufacturer of artificial fertilizers, senior member of the celebrated scientific partnership of "Lawes and Gilbert."

Mr. Lawes at an early age instituted on his Rothamsted estate a series of field experiments upon soil exhaustion and rotation in crops. In the following letter, after commenting upon the points which particularly interested him in Professor Johnson's lectures upon the same subjects before the Board of Agriculture in 1872, he expresses his recently proclaimed intention to provide for the permanent maintenance of his Rothamsted institution.

(J. B. L. TO S. W. J.)

Rothamsted, St. Albans, Nov. 7, '72.

Dear Sir,—I have read with much interest and pleasure your paper on soil exhaustion and rotation of crops, and I beg your acceptance of a summary of our clover experiments, by which you will see that we have altogether failed to grow clover by means of manures placed at different depths through the soil. I think we have almost exhausted all ordinary modes of field experiments, and I am disposed to think that the solution of this problem will not be effected until more refined investigations are commenced. We are obtaining some very interesting results on a piece of permanent pasture, which at the commencement of the experiments consisted of a fair proportion of graminaceous and leguminous herbage. For 16 years a portion has been manured with mineral manure alone without organic or nitrogenous substances. Another portion has the same minerals with 100 lb. pr. acre of nitrogen either as nitrate of soda or salts of ammonia. Where the

nitrogen is applied the herbage becomes almost entirely graminaceous, the leguminosæ being killed (not choked); where the minerals are used the leguminosæ have very much increased. In some instances, as in the case where 275 lb. of nitrate of soda is applied every year, the produce of hay annually is about the same.

The mean annual produce of hay for 16 years is:

	ewt.
Minerals only	35 1/2
Nitrate of soda only	36 1/2

The nitrogen in the produce is higher where no nitrogen has been supplied for 16 years than it is where 100 lb. has been supplied annually. An analysis of the soil of these plots would be very interesting if our processes are sufficiently accurate to be trusted. You may possibly have heard that I propose to place my Laboratory, and fields, in trust at my death for the benefit of science, and to endow it with a fund.

Yours truly,

J. B. Lawes.

Interest in Professor Johnson's paper on soil exhaustion and rotation of crops—a subject then less familiar to the agriculturist at large than it is today—was shared by the United States Department of Agriculture. In October 1872, the Honorable Frederick Watts, Commissioner, wrote:

I have read with much interest and profit your "Soil Exhaustion and Rotation in Crops," and it induces me to ask you to prepare an article to be published in the next Annual Report of this department on the subject of the different crops and different manures and the relation which they bear to each other.—I do not mean to dictate what shall be the *title* of any article, but merely to suggest a general subject, leaving you to determine what shall be most practically useful to the agriculturists of the country.

Two years later this same paper on soil exhaustion was reprinted in the Report of the Michigan Board of Agriculture—"for the information of farmers in our state." Its numerous previous republications, either in whole or in part, had by this time made it public property—Mr. Goodale, secretary of the Maine Board of Agriculture, said in a letter dated August 24, 1872:

I have just been looking over your lectures given at Danielsonville and being impressed anew with their great value I write now especially to ask if you would be willing for me to reprint them in my next report—and I would like to preface them with a notice of "How Crops Grow" and "Feed," commending them to a place in every farmer's library. The lectures would so effectually justify, endorse and enforce the commendation.

In May 1873, Professor Johnson, as chemist to the State Board of Agriculture, made his report on "Ash of Tobacco." This report was the beginning of years of work and experiment of the greatest value to the tobacco-growing industry of Connecticut. The investigation then begun has since been prosecuted by the Connecticut Agricultural Experiment Station, and in view of the permanent importance of this work still going on, it is curious to see reflected in a letter of the time how lightly it was then regarded by the interests it most benefited and how precarious was the very existence of the Board of Agriculture, whose modest appropriation alone made possible the execution of the analyses involved in the research. Professor Johnson's private assistant of the year before wrote, in 1874, inquiring as to the continuance of this work, as follows:

(E. H. J. to S. W. J.)

Falmouth, July 17—Aug. 11, 1874.

My dear Professor,— . . . I have seen no eulogium on the yeomen of Conn. coupled with an announcement of the establishment of an Agricultural Experiment Station in Conn., and so conclude that either Mass. papers are not alive to the absorbing question of the day or that the measure has failed to go through. . . . I remember that when I left New Haven there was some uncertainty as to the continuation of the Board of Agriculture. My object in writing now is to enquire whether that body has outlived the Legislature and whether you expect to continue missionary labor in that field. If so, and if agreeable to you, I should like to continue my labors as last year. I feel that another year of your kind tuition would be of great advantage to me before going "into the world where I must meet tribulation" and I think I could accomplish more another year. I am sorry to hear that you are still at work in New Haven and hope you will take time during this month for some relaxation. Don't cut the Adversary off without one chance for finding mischief for idle hands. Very truly yours, Edward H. Jenkins.

When, in April 1875, Mr. Lawes acknowledged the receipt of the Report on Tobacco, he said:

In reference to the recovery of 76 per cent of the Nitrogen supplied in Mr. Alden Smith's crop as compared with 50 in my crops, you must remember that my calculations are based upon the increase obtained over the unmanured produce or over the mineral manured produce,—if I used Phosphates and Ammonia I deduct the whole produce obtained by the phosphates without Nitrogen. Large as my loss of Nitrogen in artificial manure appears to be, I have reason to think it will be exceeded by that in the farm yard manure. After 20 years application of dung to Barley it was stopped in 1872, and we shall see in a few years what is recovered. I forward by Book

post 3 copies of a short paper I have recently published. There is nothing particularly new or interesting in it in a scientific point of view, excepting that relating to Root crops and their inability to take up organic matter as such from the soil. For a long time I thought that one of the properties of Roots, such as mangolds, turnips, etc., was to obtain carbon from already organized matter, but after 30 years experiments we have no evidence of such a fact. Farmers here cannot understand my views concerning the exhausting nature of Roots, they are so accustomed to consider them as great increasers of fertility.

Early in February 1874, Mr. Crandell, of the New York *Tribune*, begged for all possible promptness in forwarding "copy," and closed his letter thus:

I am highly pleased with the article on the true uses of scientific theory, and worked it for a place of honor in the next issue. It will, I trust, serve as an antidote to the Gradgrinds and it throws an unexpected boomerang at the heads of certain flatulent individuals who send me high-sounding disquisitions about things they do not understand.

A few days later, Mr. Crandell wrote:

The review of Bussey Bulletin reaches me too late for next *Weekly*, but it has salt sufficient to save it till another issue. It is just the sort of thing I wanted, and shows the immense advantage of having a job done by a man who has his "Forte."

Professor Storer's graceful appreciation of this review follows:

Jamaica Plain, Mass., 20 Feb. 1874.

Dear Johnson,—Thanks and thanks! I owe you debts of gratitude both for the writing of sweet discourses and for the sending of them. Pleasant it is to get a whiff of sympathetic appreciation of one's points and of one's attitude.

Besides, I have reread with an entirely impersonal interest your reply to "S. G." and have found it in that sense a remarkable, neat bit of professional exposition.

N. B. Why don't some of you Conn. folk send us the "State Reports" of that ilk? We have nothing since 1869, if my memory serves me aright,—I thought it "rough" that I should first see (or hear of) your article on leached ashes, in the N. Y. *Druggists' Circular*.

In October, Professor Storer wrote commenting with approval upon some of Professor Johnson's contributions to the *Tribune*. As these articles often found their occasion in erroneous statements widely believed and repeated by many writers for the agricultural press, they were at times unavoidably controversial in tone.

Jamaica Plain, Mass., 20 Oct. 1874.

Dear Johnson,—It occurs to me that if I don't send my benediction soon there will be small sense in speaking at all.

I was curious to see if anyone would catch *the* point of H's discourse. The blunder was so stupendous that I was forced to study my own skreed before I could believe my eyes. The thing hit *me* instantly, of course, because repeated observation (during the three years) has enforced the lesson that W——'s Superphosphate was very poor stuff. But I had doubt whether others would notice the pit which H. had dug for himself. I said,—for my own part—"Give a rogue a rope!"—"Tis a crying shame that I can never have a talk with you! Yours sincerely,

F. H. Storer.

Other letters which passed between the friends discussed various topics, agricultural and professional. At the time these were written only a tentative beginning had been made in the study of the basic problems of animal nutrition; crude and unscientific notions on

the subject were widely current, the fallibility of which was not proven. "Captain Pierce's critters" alluded to in the first of the following letters were the victims of experimental feeding similar to that inflicted upon the better-known cows of Mr. Miller.

Jamaica Plain, Mass., 11 April, 1875.

My dear Johnson,—Strange to say I know your handwriting at sight. That I am glad to see it goes without talking. I am proud and happy to expedite the Bulletins to their several destinations. Pray let me know of any one who may care to see them—or rather make him let me know. I can tell from my own sentiments how you must loathe to touch pen to paper. Were it not for this standing horror I would write you triweekly. Thus, I wanted to ask didn't Capt. Pierce's cattle gnaw boards or "browse," or something such, what time they ate the corn *per se*? There is an old sea yarn to the effect that a ship's carpenter saved the cow's life, after the hay had gone overboard and she was reduced to a diet of meal, by gradually planing down a spare spar and occupying her paunch and grinders with the shavings thereof. Many a Nanny goat has been saved on long voyages by a ration of barrel-hoops enlivened by bits of biscuit, and the traditions of seafarers emphasize the hoops more than they do the grain product, possibly of course because the latter had to be sparing.

That is a very interesting lead, which I hope you will follow to the other end.

I read your skreed on commercial manures with great interest and commendation—as I do all your *Tribune* articles.
Thine,

F. H. Storer.

New Haven, Connecticut, Apr. 17, 1875.

My dear Storer,—Yours and the Bulletins and the spurned guerdon are all safely rec'd with thanks. I must rise to

explain how mortified I was on reading that Cob article, after it was printed, to find what I *hadn't said*. And the browsing of Capt. Pierce's errors was a point I explicitly asked him about, and intended explicitly to state and intended also to query about the browse of Miller's cows, but with a head pothered about too many things and no digestion to speak of to bolster it, I got off the track, misled a trifle by the query whether bulk of *Rohfaser* is needed, and hurried by many things undone and having to write piecemeal. Bah! O for a lodge!—that last looks like *dodge*, well *call* it *dodge*, that'll do as well as lodge!

The *Tribune* "euchred" me (whatever that is!) into another year's query answering. I like it for it leads me to meditate on many interesting things, and I don't like it for it compels me to attend to many stupid things. I tried to sear the ag. editor off by naming a loud price, but he swallowed my hook and I am a literary hack for 1875, at least.

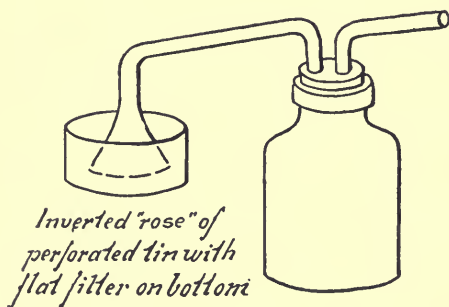
You may have noticed that we have been stirring the Exp. Station question here, last two winters and summer—I don't suppose the General Assembly of Conn. will do anything about it except refer it to the next Gen. Ass'y, but the talk will do good and there are a good many fine old farmers and bright young farmers in Connecticut (as elsewhere in New England and westward) who are getting their ag. College education out of the discussions. Then the S. S. School has an interest (manly one) in doing good to the Conn. farmers.

My Sisyphean boulder now is a new edition of "Fresenius' Qualitative" translated into new system—a real need for our School, and my last push to the Sheffield Laboratory, as I am no longer Professor of "Analytical" and have given the Labty over to Allen and Mixter, simply sitting up aloft among the thunder, a kind of Jupiter of reference, and when I get gray and fallow enough—and I haven't long to wait,—shall be merry within, at the awe I may inspire among the youths.

By the way, we have analyzed a corn cob, and it doesn't come up to the entkörnte maiskolben aus Steyermark that

Stoeckhardt's young man analyzed, and that Wolff, v. Gohren, Kühn, etc., quote as a "mittel." Haven't the figures here in my Trumbull St. attic, but will publish them by and by.

I have done a heavy amount of work on P_2O_5 estimations during two or three years past, mostly with negative results, don't know as I shall ever get time to write up. Before Carius published, I had satisfied myself that pure H_2O and common air yield NH_4NO_2 , at temperature from 20° to 100° Centigrade. I never did believe half of Schönbein's facts, and now that Carius finds that ozone doesn't oxidize nitrogen, I wish old Schönbein were alive again to hear it! As to P_2O_5 , I find that Otto's use of \bar{T} to keep up Fe_2O_3 and Al_2O_3 when you ppt. P_2O_5 with Mg solution is simply perfect, if you use enough \bar{T} , enough to give a greenish-yellow solution and 5 to 10 grams of \bar{T} doesn't impair the result seriously, but if you use too little \bar{T} and have a reddish-yellow solution, you have an imperfect separation of P_2O_5 . \bar{Ci} is of no use, Church Ville, and De Vill to the contrary.



Thought I had a method for coming it over the superphosphates in one *coup*, viz., to aqueous or acid solution, with Fe ; Al , $CaSO_4$, &c. &c, add *q. s.* $(NH_4)_2\bar{T}$, $MgSO_4$, NH_4Cl and NH_3 —filter on inverted "rose" of "perforated tin" with flat filter on bottom, wash, without transferring ppt. moisten with

concentrated $\text{Mg}(\text{NO}_3)_2$ sol., dry, ignite, solve in HCl and titre with Uran; but the Ca and Mg in variable and large quantities destroy the nicety of the Uran method. There was no trouble in getting out all P_2O_5 , free from Fe and Al. In presence of much Ca, its nasty tartrate bothered the filtration also. I may make something out of it yet, but couldn't hitherto get with it so quickly and goodly as by the molybdic method,— MoO_3 for which, through Mixer's commercial talent, I get of B. for \$8 per lb. (1/2 kilo) instead of the \$12. he so accommodatingly charges. Goodbye. Come and see me and believe me, Yours as ever,

S. W. Johnson.

Jamaica Plain, Mass. 27 April, 1875.

Dear Johnson,—I rejoice to learn of your release from analytic drudgery, and do heartily congratulate you in that regard—and the country at large likewise. I am steadfast in the faith (as I always have been) that the day of agricultural students is not very far off. I even dare to hope that it may come in our time, and I am sure that nothing can tend more forcibly to help the tardy birth than the putting of yourself into that state of “unencumbered leisure!!! and mind at ease” which the poets dream of.

I shall look now for the speedy issue of those works, on “Tillage” and on “Foddering”—especially the latter, for which the country is clearly ripe and yearning. . . .

What you say in praise of many of your Conn. farmers, and of the progress of things in your state, consists entirely with the opinion I had formed from reading Mr. Gold's reports. The excellence of the Connecticut reports is assuredly a standing proof of the good influence which the Sheffield School has exerted upon matters agricultural. 'Tis a point which Yale may congratulate herself upon—freely. You are quite right to stand by the *Tribune*,—and the *Tribune* will be foolish if it lets you slip; 'tis a standing wonder to me, though, how you can turn off such good talk at such short notice and under

your stress of work. Davenport Fisher (now of Milwaukee) expatiated to me last autumn in the warmest terms of the good you were doing at the west through your *Tribune* articles. Speaking of P_2O_5 , I have been impressed of late by the personal knack required to get good results, or rather, I have encountered two or three analysts *otherwise good*, who perversely insisted in dragging down MgO in their double phosphate of $MgONH_4$, while the rest of us were making excellent weather with the same reagents and with the same "light." I have noticed also repeatedly that in presence of a large excess of Na_2SO_4 the yellow phosphomolybdic ppt. is often fearfully sluggish, and can be moved only by an enormous excess of the precipitant. Yrs, F. H. Storer.

After the exchange of several letters with Professor Italo Giglioli, later director of the Agricultural Experiment Station at Rome, arrangements were concluded for the translation into Italian of "How Crops Grow." On April 9, 1875, Professor Giglioli wrote:

I need not tell you how glad I will be if the Italian edition of "How Crops Grow" contain your latest additions and corrections. . . . I see with pleasure that you take interest in the progress of the Agricultural Sciences in Italy. Our Agricultural Stations are as yet very young, and have not yet taken that practical turn which is so necessary in order to render them accessible and acceptable to the class of Agriculturists in general; it is to be hoped that gradually they will adapt themselves better to the *local* wants which surround them. In the United States, where the people have enjoyed for such a long time the blessings of an excellent general education, liberally bestowed on all classes, you cannot have any idea of the difficulties and opposition that surround those who want to improve the Agriculture of this country. . . . American Agriculturists ought to take interest in Italian cultivations now that some of these seem to have

been introduced in California. I am glad to hear that you hope coming to Italy.

Twenty-five years spent under unwholesome conditions had greatly affected Professor Johnson's health. He had practically lived in laboratory air, heavily laden with noxious fumes; to this was added brain fatigue induced by literary work. He struggled on through the labors and disappointments of this year—the account of which belongs to the story of the establishment of the experiment station—until the summer, when, to bear his share in building up the sub-section of chemistry just formed in the American Association for the Advancement of Science, he went to Detroit. Before starting on this long, hot journey, he joined for a short time his friends, Professor and Mrs. Norton of New Haven, at their country home on Shepard Hill, Holderness. The peaceful beauty of the New Hampshire hill country was very dear to him, and this hospitable home, always freely open, was an accustomed refuge. On his return to New Haven he found a note from Professor Norton commenting upon his activity at Detroit:

I see by the paper you sent me that you have fully shaken off the Holderness laziness, and set to work again. Reading half a dozen papers at one session is a rather precipitate recovery from the quieting influences of this region.

When Professor Johnson attempted to resume his college duties at the beginning of the fall term, it became evident that he was seriously unwell. After a few months under the care of physicians, he went abroad, in the hope that an entire change of scene would expedite his recovery.

Just before his departure, a correspondent told of discouragement and failure in the attempts made in Virginia to secure legislation for the prevention of frauds in fertilizers, and alluded to reports which had reached him that "the protective legislation of your state and section has resulted in failure." He went on to say:

In view of the spirit you have manifested in devoting your professional skill and experience to the service of the public, I would ask the favor of a condensed review of the whole subject, presented; especially of the remedial legislation had, its success or failure, and the causes thereof. Please give your views on the reliability of chemical analysis as a test of agricultural value. . . . As your reply will be of general interest, and especially valuable to the struggling farmers of eastern Virginia, I beg that it may be made public in whatever manner you may deem best.

But overworked nerves had asserted their right to rest and this letter was filed away, its request disregarded. On hearing of his proposed trip, Professor Peter Collier, an early pupil of Professor Johnson, and later director of the New York Agricultural Station at Geneva, wrote:

I heard some time since of your poor health. . . . Atwater called to see me a week ago, and is going into the Experiment Station work. I certainly hope under your advice, and had hoped under your supervision, for the pursuance of this work in this country by anybody not under you is playing Hamlet with Hamlet left out, as you and everybody else knows. . . . Now I don't wish you to answer this letter unless you have lots of time and feel like it, but I do hope to hear you are better,—yes, quite well. . . .

Professor Johnson wrote home with great regularity during the four months of his absence, in spite of neuritis, then called "writer's cramp." His first letter tells of pleasant acquaintances made on ship-board:

Cunard steamer Parthia at sea, about 200 miles from Queenstown, Jan. 14, 1876.

Dear wife,—I am near the end of the ocean passage and for the first time on the voyage sit down to write a letter. . . .

We carry but some 25 cabin passengers and there is plenty of room, good ventilation, excellent attendance and general sociability. The Captain and officers are pleasant men, the sailors are jolly and tarry (tar-y), and the passengers are mostly good fellows and appear to be very well met. Most of the latter are business men. Two from California and Nevada, two from Cape Colony, six from Canada and the rest from the "States." Pleasant people are Mr. and Mrs. W. H. F. of New York, going with two children to south of France and Italy. Mr. F. is a brother of M. F., who wrote a pleasant book of Recollections of Distinguished People, or something of that sort, which I read in the Club not long since. Mamie F. is a solid damsel of ten years, who takes her rations even worse than I do, and manifests an amount of bodily energy quite astonishing. Willie F. is a six year old, I should judge, and he and I are both very fond of bear stories. His bears always swallow a small boy and then burst. Well, now I must stop and walk deck for an hour or so, for the heat rises in this poor head of mine and the cold goes down my boot-legs to the toes, and that is a warning not to be slighted. . . .

The dose of fresh air which I have had since leaving home is something big. . . . The smoking room on the top deck is the scene of most hilarity. With three exceptions all the male adult passengers smoke and drink. The smoking room just accommodates us all, and whist, "Hot Scotch" (a drink),

songs and yarns serve to sacrifice the hours. I drop in now and then, when it is dull elsewhere, as when tired of walking, or in cold or rain, or when cold, and take a hand in the talk, or enjoy a quiet snooze. Last night a quiet-mannered man but a determined-looking one, from 'Frisco, undertook to make a time and ordered up the drinks until *he* got quite unsteady, but the other imbibers kept their heads and got the Captain to stop the supplies. This made a muss and 'Frisco went for the Captain, but was let down so gently that he seems to feel almost happy again today. He only brought \$10,000 gold for his four months amusement, so he says! I believe I haven't mentioned on board the extent of my supplies! We saw yesterday some porpoises jumping in the distance, but too far away for fun. This morning a ship under sail was in view to the south, but still far away. We are practically alone. The ocean is so vast that all the world's harbors are a drop in its bucket, and in steaming 2600 miles we have seen but four vessels since fairly out of New York. . . .

Another afternoon on deck with Willie F. We walked, jumped, ran and told stories. This time he wanted a snake story, so I told him of a lady who, when a little girl, fed a rattlesnake. That story, with suitable details and embellishments, was pronounced extremely satisfactory. Miss Mamie came up just in time to hear it. Then she asked if I had any little children, and when I explained the extent of my household and added that the Mother in my house was the heroine of the snake story, the children's gratification rose to the highest pitch. . . .

Now my twelfth page is almost done, and under a sky full of the stars that you may be seeing in an hour or two, under the same Dipper that hangs low over Trumbull Street on winter nights, I write goodbye and God keep you. . . . To all,
best love, S. W. J.

While in Liverpool he greatly enjoyed seeing once again an old friend of Munich days. He tells of this

in a long letter written in London, extracts from which follow :

(S. W. J. to E. E. J.)

Jan. 19—Feb. 8, 1876.

. . . Returning on Tuesday to my hotel (in Liverpool), I found a messenger with a note from Mr. Muspratt, and I at once accepted his invitation to dine that evening. Meeting him at his office at five o'clock, I found him fuller faced and heavier than 20 years ago, but quite recognizable and very cordial. We went by rail some four miles to Seaforth at the north entrance to the Mersey, and soon walked thence to Seaforth Hall, built by his father 35 years ago. After warming my toes at the grate in his den, I was escorted to the dining-room, . . . there was introduced to Mr. James Muspratt the grandfather, 84 years old but as hearty as talkative, and, bating a little deafness, as young as any of us. Also to Miss Muspratt,—the next day she was to go with her father to Cheltenham to enter the new *Woman's College*. The dinner passed pleasantly, Muspratt being a capital talker and well posted in American affairs and a great friend of the North.

In this dining-room hung a superb portrait of Liebig by Frautschold, very similar to the engraving Brush gave me, but painted since Liebig's death and a better and truer as well as more beautiful portrait. After being shown all the pictures, busts and statuary, in the dining-room, library and hall by Mr. James Muspratt, I went with Mr. Edmund to take a smoke, and an hour or two passed in pleasant chat until at 9.30 the cab came to take me to the station. . . . Next day brought me to London.

. . . Friday and Saturday I walked about town through the once before visited streets, Oxford, Regent, Strand, Cheapside, Piccadilly, Pall Mall, etc. The old landmarks mostly remain, but many new ones have appeared. The shops are vastly more brilliant, the statues and fine buildings more numerous than 20 years ago. London is in fact improved in

the very heart of it and a grand city it is. I never appreciated it so fully as I do now. When I was here before I was in haste to see much in a little space and saw everything very cursorily. Now I have walked day after day through the same streets, those I have named, and the solidity and grandeur of the public buildings, monuments, etc., impress me more. . . .

Yesterday morning Mr. Elliott of the *N. Y. Graphic* proposed a walk to Regent Square where stands the Presbyterian Church which was built for, and first preached in by, Edward Irving. We found it in 15 minutes travel in what 50 yrs. ago was the best part of the city and is still very good. Going into the gallery we found a large and handsome building well filled with a most intelligent and attentive congregation. The shelves of all the pews were black with Bibles and hymn books, completely covered, in fact, with them. In the pulpit the Rev. Dr. Dykes, a fine solid-looking man, was speaking in a most pleasant and dignified manner. This discourse was upon the government of the church and was very learned, very thoughtful, very sound. I was a Presbyterian again. . . . Coming home after church I had a desperately hurried dressing for dinner out, and after getting myself in passable order with my best clothes, rode in cab to St. John's Wood. Reached there just in time, was very cordially rec'd by Mr. and Mrs. Stevens. . . . Then Mr. Stevens walked with me to the "Zoo" where we saw the turtle 200 years old (900 lbs. weight), the elephants, etc., but hurriedly and but few of them as it was late. Returning, we had tea and afterwards talked until 10 P.M. when I rode nearly home in a 'bus for three pence. . . .

Last evening I stepped into a church where evening service was going on. I found a small audience, of women mostly, with four clergymen officiating. The service was intoned. The music was simple. The sermon was an earnest one by a very young man. I was very tired and the service was medicine to me. . . . I remain quite undetermined when I shall

move on to Paris. The annoyances of travel really begin on starting out from London, and I feel entirely unequal to encountering them. . . .

I hope *you* will try to get some rest,—try to get into restful habits. Age is coming upon us and it will not be profitable or pleasant to wear out too rapidly. . . . Sunday I heard Monsignor Capel (Pope's Legate) preach in the Chapel of the Assumption. A very excellent sermon he gave, that would have been in all respects acceptable in Trinity or Center at New Haven. . . .

In London, Professor Johnson found his surroundings comfortable and homelike, he was able to rest, and so lingered until Dr. Uricoechea, then living in Paris, took the strenuous measures indicated in this note:

Now you lazy boy, you get up and leave your nasty foggy climate. True we have not very good weather now here, but it is much better than yours at all events. I write to you in a hurry because I receive this very moment a letter from the Secretary of our Legation who is coming over on Wednesday, and I pray him to take you along. Mr. Guzman will probably call on you personally. Hurry up! . . .

Mr. Guzman called, his diplomacy won the day, and Professor Johnson cheerfully accompanied him to Paris, where he spent a delightful month with friends, old and new. Letters to his family tell of this and of his trip through Italy:

(S. W. J. to E. E. J.)

Ma chère Elizabeth,—I came abroad for change and I have it. Wednesday morning at 7 o'clock my friend Mr. Guzman called for me in London, and in a trice I was with him in the

cab on the way to Charing Cross Station. . . . Two nights I have slept in a 5 franc room, on the "1st floor" (2d story) in a pleasant but cold and noisy corner room. Today I have ascended "au troisième" . . . Guzman is near at hand on the same floor. I have thus far adopted the habits of the country—begun the day at 9 o'clock with *café au lait* and a *petit pain*—this morning I ordered *trois petits pains*. At 12 Guzman and I meet Uricoechea at the Hotel de la Concorde, 26 Boulevard Malsherbes, which is close by. Breakfast there is eggs or *côtelettes de mouton*, b'fsteak, cold meats, etc., with excellent claret. At 6 P.M. we dine at the same place, a regular 5 courses, and excellent cooking and service. English and German spoken there by the waiters, as well as here where I lodge. The first day of our arrival we dined here and it was very good, but not so "fine" nor so good company as at the Concorde. Uricoechea looks very well, not quite so well as eight years ago (almost) when at New Haven—he shows a little gray hair on the temples—but still quite well. . . . When we arrived here Wednesday evening (Mercredi, I must make a "Section" now and then) we entered the *salle-à-manger* where the dinner was in progress, and immediately the landlady bounced upon Guzman, seized his hands, then patted his face, then kissed him—a compliment he returned very beautifully—both talking and laughing with genuine joy all the time.

Guzman was very enthusiastically received also by Mr. Pacheco, a Peruvian gentleman, and in a less pathetic manner by an English lady staying here. Shortly Uricoechea arrived and then we both embraced, etc., very glad you may be sure at this meeting which a little while ago was not in our programme. After dinner we adjourned to Mr. Pacheco's room, on *our* floor and spent the evening until 11 o'clock. Mr. P. speaks English, having learned it in the U. S. three yrs ago where he traveled considerably. Mr. P. invited us to visit him again last evening and "assist" in a Chinese lesson he was to take from a Chinaman educated in French, Latin, etc.

by Jesuit missionaries in China. Mr. Pacheco speaks, as his mother tongue, the language of the Incas, and is desirous of studying Chinese on account of the many resemblances. In due time Mr. *Ting Whang* appeared, a short, stoutish, bright-eyed Celestial, attired in Paris mode, and proceeded to give the vowel and consonant sounds and the articles, pronouns and verb moods and tenses. It was very interesting. Uricoechea, who is up in languages, followed, or in many cases went ahead, and the Castilian (in descent), the Peruvian and Chinaman made lively work of it for an hour and a half, discussing each point, and practicing each sound and word. After Mr. Ting-a-Ling bade us Bon Soir we chatted together in all our languages until 11 P.M. when I retired to my refrigerator *au premier*, stirred up my embers, warmed my toes and went to bed. I didn't sleep very well, but kept trying until 9 o'clock A.M. when I got my coffee, dressed and went up to see what Guzman was about, found him *en déshabillé*. Pacheco then entered and while Guzman washed and dressed we talked *à la margot*. The speedy arrival of 12 o'clock took Guzman and me to breakfast. We found Uricoechea had been and gone. We ate our eggs and outlets, drank our bottle of excellent Bordeaux, and then I went with Guzman to his Bottier, etc., several calls, and returning began this letter. Before dinner we walked up the Champs Elysées, went to Uri's to find him out, and got around at dinner time. Uri. had been all day in the Library. The table at the Hotel de la Concorde was quite brilliant, Guzman at head of table, Uricoechea next on my side, then myself, then Mr. Baron Capitaine Something, then Madame Quelque Chose, a quite nice old lady, then a young Madame, then Miss John Bull very healthy, etc. On the other side of the table opposite me, two French damsels—their papa looking like a country parson, and others not particularly discriminated. The Baron next me talks English, has a chest like a barrel, from much fencing and other athletics I should say, and a voice like a locomotive. After dinner *we* adjourned to the Salon for

coffee, where conversation kept the party together for nearly an hour.

. . . The Madeleine is the only church I have been in during service. Today I went with Mr. Pacheco to the Louvre. . . . Here and now, as of old in Germany, I find more pleasure, with few exceptions, in modern works, both paintings and sculpture, than in antiques. It's very stupid, doubtless, but I can't help it, and I also enjoy seeing men and women more than looking at monkeys. Perhaps that argues for Darwinianism? The galleries of the Louvre are very fine, good light,—warmed, most of them,—the rooms themselves are often more elegant and interesting than the objects they contain. This morning we walked for nearly two hours through modern sculpture—none less than 100 years old; paintings, from those like the Jarves collection down to French work of the last century, room after room; vases and small sculptures in agate, quartz and semi-precious stones; and finally splendid Egyptian and Assyrian monuments, sarcophagi, etc. Quite instructive and very fatiguing after the second hour.

I now think I shall move towards Italy in a few days. I begin to think I should enjoy traveling and I have almost decided upon a definite plan as follows: In three days one of "Cook's personally conducted parties" leaves here for a 30 days Italian tour under the guidance of an Italian who attends to *all the business* of the party according to a definite printed programme. . . . Railroaded, coached, lodged, fed and shown to all the noteworthy objects in the route, and duly returned safe and sound! There are objections to this mode of travel. In fact it is a humbug of the most stupidly infantile and imbecile sort, but I am in just the mood for it. It gives me an occupation without care. I will try it. If I thrive under it, I will try travel on my own account, if not, I will go home, buy a horse and carriage and a boat, and devote myself to my family and my muscle. . . .

March 14, Venice. . . . I arrived at Turin at 8 o'clock. There I found Mr. Giglioli at the hotel, having apprised him

of my coming. Had a long walk with him from 9 P.M. until midnight, in moonlight, about the city and up a high hill commanding the city. He is a very handsome and agreeable man, speaking English perfectly.—Was two years in England—his translation [*of How Crops Grow*] is shortly going to press. . . .

March 30, Naples. . . . I have enjoyed Naples and can tell you something of its glorious nastiness and beautiful environs when we meet, but I cannot write. The stone floor under the carpet is like ice to my feet, and my boots, just up from a subterranean seullery, are like twice frozen rawhide to the feel. I must be up and stirring or the chills will have me. Yesterday on the slopes of Vesuvius, the fig trees were pushing their young leaves, pear trees were in blossom, wheat was 18 inches high and the air was almost equal to that of Shepard Hill, but not quite.

Paris, Apr. 7, 1876. . . . Tuesday to Turin. Wednesday I spent in company with Mr. Giglioli. Visited the University, technical school, Ag. Expt. Station, etc. Wednesday night to Paris. . . . The month in Italy was most favorable for outdoor life. . . . As regards health, I think it is now mainly a matter of digestion, and I don't expect to get right until I have had a course of country air and bodily exercise.

During these three months of rest amid new surroundings, with pleasing society that diverted and amused him, Professor Johnson had gained steadily in nervous strength, and the prostrating headaches came less frequently. He avoided, of necessity, the people and the places that, had he been well, he would of all others have longed to see. Only in Turin had he indulged in the keen professional pleasure of long talks with Mr. Giglioli and had made careful visits of inspection to the University, the Museum and the Agricultural Experiment Station, the latter recently estab-

lished. With his return to Paris in improved health, the impulse to get back to work was irresistible and he soon started for home, where he resumed, under those abiding disabilities which such an illness always leaves, the work which was an integral part of his life. The friends who had bidden him Godspeed were there to welcome, and among the first to send greetings was Professor Collier:

Welcome home to you! I have just heard from one of my laboratory students who has been analysing fertilizers at your Conn. Exp. Station, of your return, and I hasten to congratulate you. I do hope you are wholly restored, and that you may come up to Vermont this vacation. . . . Somehow your name, and your experience, is so inseparable with that work [*Experiment Station*] that I can't but hope you may be connected with it, if only as advisory head of the concern.

After a summer spent in rest and outdoor exercise, Professor Johnson was able to resume his college work at the opening of the fall term. For the first time in many years, twelve full months had passed without a publication of any sort, and he wrote fewer non-professional letters than ever before. In response to one of the few, now lost, Professor Storer wrote on the 18th of November:

I am delighted to hear from you—and to get so favorable an ac't. Curiously eno' I had had a mem. in my note book for a week to ask Eliot if he had ever heard from you. The amount of the business is, young man, that we are both of us less young than we were some years since—and all organic chem. does go to prove that thesis. Thank the Lord I don't have to profess that branch in my old age. Permit me to remark most emphatically that three lectures a week is *not* light work for those kinds of men who steam up and who vim

it when they work. . . . Clear out those note books of yours, if you can, forthwith, for 'tis a sin and a shame to have your fellowmen run the risk of wasting their powers upon trees that you have already climbed. I was particularly anxious last summer—and so I found was Atwater—to see that paper on nitrates that you presented to the Sci. Assoc. some time since. . . .

I have missed you consumedly in the *Tribune*, particularly on account of the hue and cry about "Stockbridge fertilizers" which has been wellnigh unbearably strong in this state of Mass. That *Bruit* needed to have been grasped with a firm hand before it made much head. In view of your computation on page 364 of H. C. F. and of my own computations in C. B., as to the agreement of my expts. with mixed fertilizers,—let alone the whole tone and drift of agric. literature for years,—the taking out and yet *more* the giving, of a patent for such device was truly pitiable, as exhibiting the lowness of our status. . . .

My isolation here is little short of awe-ful. I have no colleagues for communion, no clientage of farmers, and absolutely no one but the greenest of students to talk to. . . .

I will send you Part V of our Bulletin tomorrow. We mean to get out another Part early in '77.

Poverty has reduced us to the strait of resorting to a publisher in the hope of getting some *salvage*, as his circular will explain. I will enclose it as a piece of evidence and trust that there is no need for me to add that the Bulletin is still proud to *present* itself to the elected, and that subscriptions will not be received from our kindred, whether they be men or societies. . . .

CHAPTER VII

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

To bring together the story of Professor Johnson's connection with the establishment of the experiment station in Connecticut, it is necessary to go back to December 1873. He then introduced to the Board of Agriculture at their winter meeting, as a recent recruit to their ranks and as the lecturer of the day, Professor W. O. Atwater, who had just returned to Connecticut and a professorship at Wesleyan, and who had previously been first student under and then private assistant to himself; in so doing he expressed his personal satisfaction in being able to thus show the fruit of his own twenty years' labor in education of younger men in the field of scientific agriculture. After Professor Atwater's lecture before the Board, Professor Johnson warmly advocated the establishment in Connecticut of an agricultural experiment station, and defined its proper work, speaking of "those institutions which are almost peculiar to Germany, the experiment stations, where the farmers of Germany, wise beyond their generation on this side of the water, support experimental gardens, farms and stables, and all that is essential to an institution designed not only to diffuse the knowledge which has already been gained, but to gain knowledge in a multitude of directions where, until these movements were inaugurated a

few years ago, we could see nothing but total darkness." He went on to say:

I wish that in Connecticut we might have a similar institution. . . . It is in the power of Connecticut to do this, and if we could only see the benefits that would flow from that work, if we could only be put in the position of those who in Germany inaugurated these enterprises, and have kept them up so that now there are more than forty of these so-called "experimental stations" in that country, every one of which is turning out every year new and solid contributions to the art (because to the science) of agriculture,—we should not rest until it is done. I only wish that I could give up the daily duty which it is necessary for me to follow and be a missionary in the State of Connecticut, to go around among the farmers and stir them up in this matter. If I could do that, I should feel that I might go down to my grave with the reputation of having done something for my State which I know (and which some of you who are here before me will know sometime, if you do not believe it now,) will be of more benefit than all the agencies which are now working in behalf of agriculture in this country. We are simply grinding over the old grist which our fathers have given us; we are discussing the question of fertilization, and all that sort of thing, just as was done in the days of the old Roman Empire. I can go to my shelves and take down a history of Roman agriculture, and can put my finger on almost all the good ideas which you will hear ventilated in any agricultural meeting in this country,—except those which have come within the last thirty or forty years from the investigations of modern science. Why not throw up some broader, straighter and firmer highways, whereon we can travel comfortably and rapidly without discomfort from dust, or peril from mire? Why not make the agriculture of New England the prominent achievement of her civilization? What is done in politics, what is done in war, what is done in diplomacy, may be

written in books and may live in history, but what is done in agriculture must live in the life of the people.

The next day Professor Johnson delivered, before the Board, a lecture on "Guiding Ideas in the Use of Fertilizers," in which he clearly defined some of the problems confronting the agriculturist, and made an earnest appeal for the application of scientific principles to everyday problems:

The best method of attaining truth is to endeavor earnestly but honestly to disprove what appears to be true. If you set out with the idea that you know a thing, you can very easily convince yourself that you do,—particularly if you have admiring friends who know nothing about the subject. That lies in human weakness. The only way to be certain you have got at the truth is to go counter to the current of self-complacency. If you can sit down deliberately with your supposed facts, and with your theories, and try by every imaginable test to find where they do not harmonize, or where they do not satisfy strict logic, then and not until then can you be pretty certain that you stand fair and square on that subject. That is the temper of those who are educated in what we call the scientific methods of investigation, especially as taught in the German schools. It was in that spirit that Baron Liebig instructed the students who gathered in his laboratory from all quarters of the globe to learn the art of making discoveries in science. They were set to testing the truth of some idea, or the correctness of some fact, or else to make new observations and discover new facts to lead to new ideas. It was not the novelty or the glory of discovery, but the genuineness of discovery that was regarded as of first importance. He listened patiently to their accounts of each day's progress, considered their plan of investigation, saw the apparatus or arrangements they devised, witnessed the observations they were led to, and heard the theories they imagined.

He encouraged, but he criticised. He asked questions, suggested doubts, raised objections. His students were required not only to collect facts, or supposed facts, and to connect and complement them by comparison, analogies, and theories, but they were made to attack their theories in every weak point, and to verify or disprove the supposed facts by repeated scrutiny from every side.

The science of our time is advancing rapidly because it is moving cautiously, and therefore surely, and I dwell upon this feature of scientific investigation because the facts to which I have alluded,—the facts relating to the kinds of matter required by plants as their food,—are of a positive and firmly established sort, fully deserving our credence and fit to be the basis of our intelligent practice. There are various kinds of evidence. In the schools of theology and medicine, in law, and in politics, there are numbers of doctrines, and numbers of statements which many people believe to be true and many others believe to be false. This diversity of belief arises to some degree from the nature of the evidence, which is often of a kind that cannot be conclusive. I may believe in the immortality of the soul; you may not. We can discuss this question all our days without coming to a satisfactory demonstration. Our belief, whichever way it runs, is a matter of feeling as much as of logic. The arguments which convince me are trifles to you; those which settle your conviction have no point to me. But in many things we can come nearer to the fact. If I assert that when a stick of wood burns, oxygen of the air combines chemically with carbon and hydrogen of the wood, and that carbonic acid gas and vapor of water are products of the chemical change, I expect to be implicitly and fully believed, because the evidence of those statements is of such a sort that any fair intellect can comprehend it, and evidence of a contrary sort there is none.

Before the close of this meeting at Meriden, a committee, appointed to report to the Board concerning

the expediency of the establishment of an experiment station, reported through its chairman, Professor Johnson, "their unanimous opinion that the State of Connecticut ought to have an experiment station as good as can be found anywhere, and they are of the opinion that the Legislature of the State ought to furnish the means for its immediate establishment and for carrying it forward. They recommend that a permanent committee be appointed by this convention to do such work as is necessary to bring this matter before the people and before the Legislature, and to accomplish the desired result either by direct legislative action or by whatever means may be necessary to effect it, this committee to begin now and to work until the thing is done."

During 1874, agitation for the establishment of a State agricultural experiment station in Connecticut went on unremittingly. Professor Johnson took his full share of this, coöperating with his associates in the Board of Agriculture, and endeavoring to educate the people and their representatives in the General Assembly to a full understanding not only of the benefits, but of the proper scope and necessary equipment of a State station which should be able to perform all that its friends would expect from it. He visited many places in the state, lecturing and leading discussions before local organizations of farmers. He also prepared, under the title "Science as a Means of Agricultural Progress," a full historical account of the agricultural experiment stations of Europe, and the benefits which would follow their establishment here, which was printed as a part of the report of the Sheffield Scientific School for the year. Ten thousand addi-

tional copies of "Science as a Means of Agricultural Progress" were printed by the Connecticut Board of Agriculture and distributed throughout the state, thus bringing the subject effectively before the people.

Professor Peter Collier, at this time secretary of the Vermont Board of Agriculture, wrote frequently and fully, telling of his part in the campaign for agricultural progress in Vermont. In a letter dated December 30, 1873, he expressed regret that he was unable to attend the Meriden meeting of the Connecticut Board, and in closing, said:

So you see the cause is moving, up in Vermont. I hope I may see you all again this side Heaven, but really it looks doubtful, still I hope you will not forget one who in certain respects follows you as one of his namesakes followed his Master, though like him "afar off."—

In his letter of March 7, occurs a breezy comment on the experiment station movement in Connecticut:

Are you going up to Hartford on the 24th instant? I see you are announced as expected, so also am I. Well, the good Lord has given me sense enough to know when I am not needed, and that is to talk Agricultural Chemistry when you are about, and so I write hoping to know whether you are to be there.

At the next winter meeting of the Connecticut Board of Agriculture, held in December 1874, its committee on the experiment station reported a favorable reception of the idea among that part of the community which they had been able to reach; and gave an account of a meeting of their committee before the Legislature's committee on agriculture where the subject was discussed in detail with a strong delegation of leading

farmers actively present. As a result of these efforts a bill endorsed by the committee of the Board of Agriculture had been presented to the Legislature. This bill was retained in the legislative committee on agriculture until near the close of the session and then reported with the recommendation that it be laid over to the next session of the General Assembly.

Mr. Orange Judd, editor of the *American Agriculturist* and a trustee of Wesleyan University, had already addressed this meeting of the Board of Agriculture, speaking in favor of the experiment station movement in one of its practical aspects, but apparently with no understanding of the scientific features involved. In the general discussion following the report of the Board's committee on the experiment station, he took a prominent part, finally proposing to the meeting that an association be formed and funds raised by private subscription for the immediate establishment of a station. The discussion closed without formal action, and this proposal was not again brought up in the public meetings, although it was privately and persistently agitated.

At a subsequent meeting of the committee of the Board of Agriculture, it was decided to continue their propaganda, but not attempt any other method of raising funds. After this formal decision, Mr. Judd took the matter into his own hands without any further consultation with the committee. Professor Johnson was not in sympathy with Mr. Judd's project, and when the measures advocated by the committee of the Board, which he believed to be the best and only permanently useful ones, were defeated by agencies which he had supposed pledged to the policies he repre-

sented, he refused to participate in the establishment of an experiment station as a private enterprise. The project, however, did not lack supporters, and in the spring of 1875 the Legislature, through the passage of the following resolution, secured to Connecticut the honor of establishing upon her soil the first agricultural experiment station in America:

To Promote Agricultural Interests.

Whereas, the Trustees of the University at Middletown tender the free use of ample laboratories and other facilities for establishing and carrying on an Experiment Station, for the general benefit and improvement of Agriculture and kindred interests of the State of Connecticut: be it

Resolved by this Assembly: Section I. That the sum of seven hundred dollars per quarter for two years, is hereby appropriated to the University located at Middletown, Middlesex County, to be used in employing competent scientific men to carry on the appropriate work of an Agricultural Experiment Station; . . .

An American agricultural experiment station in Connecticut was a cherished vision for the fulfilment of which Professor Johnson had long worked; at first in coöperation with the Agricultural Society, in whose meetings he had introduced the idea; later in official connection with the State Board of Agriculture, founded by a group of agriculturists who counted him as their associate and their leader in scientific thought. The result of these many years of persistent endeavor was his identification with this project in the mind of the public—he had come to be generally regarded as the man best fitted to guide agitation for the securing of a station in this country and to establish and develop

its policy. Quite naturally, therefore, when Mr. Judd introduced and carried to a successful issue his plan for an experiment station entirely different in scope from the institution contemplated by the "Farmers' committee" of the Board of Agriculture, surprise and disappointment ensued.

Under the legislative resolution this experiment station was exclusively controlled by the trustees of Wesleyan University. An impression, founded upon Mr. Judd's utterances and personal attitude, was widespread "that the purpose of this station was for the analysis of commercial fertilizers alone," and to that possible limitation was added the probability that the new institution might become committed to a short-sighted and mistaken policy, voiced by resolutions passed in a farmers' club, which stated substantially that they would patronize no manufacturer or dealer who was not willing to put his wares under the control of such an institution.

Professor Johnson had very clearly defined ideas, based on his own long experience in such work, as to the proper limitations and methods of exercising a "fertilizer control." He believed that it was not expedient "for the station to attempt any formal and systematic inspection of manufactories or store-houses of fertilizers with the idea that such inspection can in any sense be made a guarantee of the genuineness and good quality of whatever is sent out therefrom. It is held that the liability of any brand of fertilizer, if exposed for sale anywhere in the state, to be subjected to the scrutiny of the station, at the hands of consumers and in the very condition in which it is offered to them, will be the most easy, the most healthy and in

the long run, the most certain and effectual method of 'control.' It has the great advantages over any other system that it is entirely fair, that it so distributes responsibility that the station and its officers cannot enter into the temptation or incur the suspicion of favoritism or partiality; it keeps the producer and dealer constantly alert to hold their wares up to a high standard of excellence; and it exercises the caution and the intelligence of the consumer in a manner that must react favorably on every branch of his business." Professor Johnson felt that the work had not been rightly begun, and that it had been taken out of the hands of the committee duly appointed for the work by a private individual whose major interest was the success of his agricultural journal. He believed that the station should be an independent organization rather than a subordinate department of an unrelated institution, and that this public work should be done with public funds, the expenditures being approved by state officers, rather than by private donors.

Appropriations to the experiment station at Middletown were limited to two years. Before the expiration of that time the General Assembly provided for the continuation of experimental work by the passage of "an act establishing the Connecticut Agricultural Experiment Station" as an independent State institution "for the purpose of promoting agriculture by scientific investigation and experiment." The definition thus incorporated into the legal existence of the station was the fundamental one for which Professor Johnson from the first had contended—that the experiment stations of America should aim to lead research in agricultural science in this country. The State

granted five thousand dollars annually to the new institution, and identified him with its organization by the wording of the eighth section of the act, which begins, "Professor Samuel W. Johnson of New Haven is hereby empowered to appoint and call the first meeting of the Board of Control." Immediately upon organization, on April 11, 1877, he was chosen director of the station and eighth member of the Board. Three weeks later the executive committee, consisting of Professor Johnson, Professor Brewer and Mr. Webb, proceeded to equip the station for actual work. Dr. E. H. Jenkins, the present director of the Connecticut Station, and Dr. H. P. Armsby, formerly director of the Pennsylvania Station and now director of the Pennsylvania Bureau of Animal Nutrition, both of whom had been trained in agricultural chemistry by Professor Johnson, constituted at first the entire staff of the station, which—established on the basis of Professor Johnson's own previous work—soon became the model upon which other states patterned the experiment stations successively founded. It is surprising to see how well the standards set in 1877 by the Connecticut Station have been adhered to through the growth of our experiment stations into a national system, embracing the many varied agricultural interests not only of the United States, but of our arctic and tropical territories as well. Concerning the origin of these standards, it may be noted that twelve years later, when those interested in the development of experiment stations began to inquire concerning the influences which had surrounded their inception and evolution, Professor Johnson filed this memorandum among his papers:

This station was the first permanent organization of the kind in America, and has largely grown out of the influence exerted by Professor John Pitkin Norton, a pupil of Johnston in Edinburgh and of Mulder in Utrecht, who in the year 1846 became Professor of Scientific Agriculture in Yale College and by his teachings and writings excited great interest in Agricultural Science and prepared the way for the application of scientific methods and results to improving our agriculture.—

S. W. J. Oct. 1889.

In a letter written December 21, 1877; Professor Johnson said, "This station was obliged to go into operation and work three months before it received anything from the State, and now has not enough to pay its liabilities, and will not have for three months to come." The first six months' work, however, comprised: A continuation of the fertilizer work which Professor Johnson had previously performed for the Board of Agriculture; a series of examinations of seeds, made in a manner to establish their purity and vitality; the commencement of an investigation of the nutritive value of feeding-stuffs for cattle, in connection with which Professor Johnson reviewed at length—in his first "Report of Director"—a system of exclusive corn-meal feeding of cattle in winter practiced by Mr. Linus W. Miller, pointing out the necessity of consideration of all factors involved in such problems and the unsafeness of ordinary criteria, and calling attention to the fact that "the whole subject [*of cattle feeding*]*] requires to be worked up care-

* The first analyses of maize fodder, made in this country according to modern approved methods, were those executed in the Sheffield Laboratory in 1869 by Professor W. O. Atwater, who was then studying with Professor Johnson and who presented the results of this work as a thesis for his doctor's degree in June of that year.

fully, as it only can be with the methods and appliances of a fully equipped experiment station." A careful study of the relation of the soil to water was also begun during this period, and in the first Report, publicity was given to a correspondence upon environment favorable and unfavorable to the development of potato-rot and skin-crack, and to an account of the conditions under which the sugar-beet may be successfully raised.

The first bulletin issued by the station under Professor Johnson was in his own handwriting. It was made by aid of Edison's electric pen and duplicating press, and bears date of August 18, 1877. Copies of this and other early bulletins were sent to the newspapers of the state with the request that they be published for the information of readers, and to the secretaries of the agricultural societies and farmers' clubs of the state—these being the only mediums through which the station could place its publications in the hands of the farmers.

Direct correspondence regarding specific problems of individual farmers was necessarily a large part of the work of the newly established station. This has now long been superseded by the present system of bulletins prepared by specialists, printed in generous-sized editions and freely sent to all interested; but in the early years of the Connecticut Station, this field was covered by Professor Johnson's personal letters in response to inquiries on a vast range of subjects. Concerning this part of the work he wrote at the end of the first six months:

A not inconsiderable correspondence has necessarily been attended to. This has consisted not only in the exchange of

Conn. Ag. Exp. Station - New Haven Conn.

Aug 18th 1877

Analysis of "Composition for Grass" sold by
Dollard Bros Manufacturers and Dealers in Improved
Fertilizers 3 Custom House Square New Haven Ct

Analyses on Barrels { Organic and soluble Plant Food 86
Inorganic Matter. 54

Station Analysis & Valuation.

	Pounds per 100	Pounds per Ton	Value per sack of 50 lbs	Value per ton
Water	16.72	637.5		
Vegetable Matter	13.92	527.7		
(Nitrogen of veg M)	(19)	(5.1)	18 cts	56 cts
Sand & Earth	55.27	1067.8		
Potash	15	2.5	6 cts	32 cts
Soda	.23	2.8		
Lime	1.38	22.6		
Magnesia	.46	15.7		
Phosph				15 cts
Carbonic acid				

Bulletin of Connecticut Agricultural
Experiment Station, Aug., 1877

Value Estimated } per ton { \$1.03
Cost } \$32.00

As analyzed the sample contains but 4 percent of Plant Food - 76 percent is water vegetable matter & earth, not worth handling

The Lime Magnesia & Soda have indeed a small trade value, but since they accompany nitrogen Phosphoric Acid & Potash in all good high priced fertilizers, their value is included in that of the last named bodies

The Pound per Ton statement includes as water the difference between the selling weight of 50 lbs per 50 and the actual weight 20.45 lbs.

E W Johnson - Director

fully, as it only can be with the methods and appliances of a fully equipped experiment station." A careful study of the relation of the soil to water was also begun during this period, and in the first Report, publicity was given to a correspondence upon environment favorable and unfavorable to the development of potato-rot and skin-crack, and to an account of the conditions under which the sugar-beet may be successfully raised.

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 Pollard Bros. Manufacturers and Dealers in Improved
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Analysis on Barrels { "Organic and soluble Plant Food 86"
 Inorganic Matter. 54

Station Analysis & Valuation.

	Pounds per 100.	Pounds per Ton	Value per ctt	Value per ton
Water	16.72	637.5		
Vegetable Matter	13.92	227.7		
(Nitrogen of veg. M.)	(.19)	(3.1)	18 cts	56 cts
Sand & Earth	65.27	1067.8		
Potash	.15	2.5	6 cts	32 cts
Soda	.23	2.8		
Lime	1.38	22.6		
Magnesia	.96	15.7		
Phosphoric acid	.37	6.1	5 cts	15 cts
Carbonic acid & Chlorine	1.00	16.4		

Value "estimated" } per ton { \$1.03
 Cost. } \$32.00

As analyzed, the sample contains but 4 percent
 of "Plant Food." — 96 percent is Water. Vegetable
 Matter & Earth, not worth barreling.

The Lime, Magnesia & Soda have indeed
 a small trade value, but since they accompa-
 ny Nitrogen, Phosphoric Acid & Potash in all
 good high-priced Fertilizers, their value is
 included in that of the last-named bodies.

The "Pound per ton" statement includes,
 as water, the difference between the selling
 weight of 250 lbs per bl. and the actual weight
 204½ lbs.

E. W. Johnson - Director.

letters on current business, but also in response to inquiries respecting the organization and work of the station that have come from Boards of agriculture, official committees and interested individuals in eight other states, and in answers to a great variety of questions on the value or use of fertilizers and kindred topics from practical farmers in this state not only, but in many others, from Maine to Texas.

It was undoubtedly through this phase of his work that Professor Johnson came to see so clearly the real needs of the country and how the stations should be developed to meet them.

For five years the station was housed in rooms loaned by the governing board of the Sheffield Scientific School. In spite of small means and cramped quarters, the institution was able to demonstrate its usefulness. Creditable beginnings were made in several lines of research. Professor Johnson inspired these and aided in their prosecution; he also devoted much skill and ingenuity to developing and perfecting laboratory methods of analysis, many of which are standard processes today.

In 1882, the station moved into a house of its own, with an annual appropriation increased to eight thousand dollars; and, under a new fertilizer law, the license fees paid by all dealers in fertilizers in the state also became a part of its income.

In 1887, the passage by Congress of a bill popularly known as the Hatch act granted Federal funds to the State experiment stations, and provided for a central advisory bureau under the control of the Department of Agriculture. The first "object and duty" of an experiment station mentioned in the Hatch act is "to conduct original researches or verify experiments on

the physiology of plants and animals''; and the first use made by the Connecticut Station of income from the Hatch fund was to establish a new department for the investigation of fungous diseases of plants. Dr. Roland Thaxter (who resigned after three years' service to accept a professorship in Harvard) was the first mycologist in charge of this department. During his term of office he identified and described the organism causing potato-scab—*Oospora Scabies*—which had long been uncertain and a subject of controversy. His successors in the department have maintained the high standard set at its inception. In 1889, at Professor Johnson's desire, Dr. Thomas B. Osborne, a member of the station staff, undertook a study of the nitrogenous matters contained in the kernels of oats. This investigation also was supported by the income of the Hatch fund. It proved to be the beginning of a sustained research in protein chemistry which has developed—in a laboratory of the Connecticut Station—without interruption up to the present time. Lately, through aid from the Adams fund, and in coöperation with the Carnegie Institution of Washington and with the Sheffield Scientific School of Yale University, the scope of this work has been extended to include many important problems of nutrition and growth.

While gathering together, in the autumn of 1871, material for his essay on soil exhaustion and rotation of crops, Professor Johnson was so impressed by the unsatisfactory and meager data available as a basis for the estimation of nutritive elements removed from the soil by the growth of tobacco, that he omitted all reference to this crop of so great importance to the

farmers of the Connecticut Valley. He then set about an investigation of New England tobacco, which is recorded in his "Report on Tobacco" made in May 1873, to the Connecticut Board of Agriculture; it comprised analyses of the ash of the tobacco leaf of the Connecticut Valley and a discussion of the requirements of the tobacco crop. In 1891, he directed the energies of a part of the station force to a continuation of this investigation, in the field and in the laboratory. The educational value of his initial work on tobacco is indicated by the formation, in 1892, of the Connecticut Tobacco Experiment Association, comprised of tobacco growers who formed a joint stock company "for the purpose of conducting and carrying on the business of an experiment in the culture and cure of tobacco . . . in connection with and under the supervision of the Connecticut Agricultural Experiment Station." The association at once purchased a suitable plot of tobacco land, and erected a barn to hold the crop, and a scheme for five years' experimentation was adopted. Experimentation on tobacco has ever since been regularly carried on by the Connecticut Station under the personal supervision of Dr. Jenkins, who, first as vice-director and then as director of the station, has guided the expansion of this work until it has become as essential to the tobacco industry as is the station's fertilizer work in the operations of the non-specializing farmer.

When a good beginning had been made and Professor Johnson felt reasonably assured of a future for the tobacco experiments, he turned his attention to the establishment of a horticultural department. This problem was worked out in his accustomed simple

method. He did not wait for popular demand for the service he proposed to render, he was not unduly troubled as to how or whence its support should be forthcoming. He laid a foundation, concerning himself chiefly with the all-important right beginning, and left the outcome to the future, convinced that once the work had demonstrated its own value and utility, support would follow as a matter of course. The coming—as horticulturist—of Dr. Britton, the present state entomologist, to the Connecticut Station in 1894, marks the commencement of another phase of its activity. Today, we in Connecticut, as in all other states, can freely obtain advice or help in combating the ever-present foes of our orchards and gardens; warnings are given us of the coming of destructive insects, methods for their control or extermination are published broadcast; preventive spraying of trees is the rule, not the exception; and much accurate information upon local horticultural questions is gained through scientific investigation and widely spread by means of station bulletins—and only twenty years ago, all this was not!

In 1894, Professor Johnson prepared a general food law which, excepting the law in force in Massachusetts upon which it was largely modeled, was practically the first effort at food legislation in this country. This law, when presented to the Connecticut Legislature, was passed at once by the House but was almost unanimously defeated in the conservative Senate. When, in 1895, an attempt was made to pass a special lard law, on the ground that it was impossible for honest manufacturers to meet the competition of Chicago packers of adulterated lard, the Legislature decided

to enact no more special laws, but a general law covering all food products. The law prepared by Professor Johnson and rejected the preceding year was accordingly taken from the archives and passed with scarcely any opposition. This law remained in force until 1907, when it was supplanted by the present law based on the Federal Act which, in the opinion of those in the state best fitted to judge, has not proved its superior effectiveness.

Under the individualistic direction of Professor Johnson, the Connecticut Station made most significant demonstrations of possibilities in various lines of research, some even in fields where practical returns appeared very remote. His later life was as marked by wise progressiveness and freedom from the prejudices acquired through habit as his early years had been by the common-sense conservatism more usually associated with mature years and experience. This happy constitution of mind enabled him to keep in sympathetic touch with the progress of events around him after ill health prevented participation in them.

Professor Johnson's earliest expectation was first to develop agricultural schools and colleges in this country; at that time his belief was that experiment stations would grow naturally out of them and, while, perhaps not necessarily an adjunct, would at least be closely related to some teaching foundation. All students in the agricultural course of the Connecticut College of Agriculture and the Mechanic Arts (Sheffield Scientific School) came under his instruction and observation. This institution fitted men to teach and

advise the agriculturist. These men were qualified to investigate and to administer; they have held almost without exception positions of influence, carrying on and extending studies begun under Professor Johnson's tuition. But the student desiring to become a trained agriculturist was infrequent. He who wished to equip himself for a business career in agriculture, who looked forward to attacking successfully the problems sure to arise in a new profession, to the creation and development of agricultural resources, was a rarity.

Yet this professional agriculturist, trained in science, employed not in teaching but in the business of agriculture, was—so felt Professor Johnson—the indispensable instrument for the agricultural salvation of our country. After years of experience as a teacher, he came to the conclusion that scientific education of the agriculturist must begin elsewhere than in schools and colleges, that before these could reach the full measure of their efficiency, the agricultural stations must break the ground. That accomplished, from a constituency educated to use and appreciate the station would come men fitted to study and conduct practical scientific agriculture. Acting upon this mature conviction, he used the influence of his position as professor of agricultural chemistry in the Sheffield Scientific School to further in every possible way the cause of the agricultural station, which was finally established in Connecticut largely through his efforts and in response to his oft-repeated and urgent entreaty—an entreaty so well expressed in his widely circulated appeal written in 1874:

To say that the farmers of Connecticut and of our entire

country urgently need the aid and stimulus of the Experiment Stations is to make a most evident assertion. Our Agricultural Colleges have but few agricultural students.—The reason lies mainly in the fact that our intellectual activity has the habit of running in other than agricultural channels. To bring our farmers in direct and profitable contact with the results of science, to bring science into active and visible coöperation with the toils and plans of the farm, would redound to the eminent advantage of both. The Experiment Station, I cannot doubt, is to be this point of contact, the focus of this coöperation.

The quarter century, now just completed, of our national system of agricultural stations witnesses the fulfilment of Professor Johnson's forecast made nearly forty years ago, and now realized even beyond his serenely confident expectation. The proved usefulness in Connecticut of a few fertilizer analyses accurately made and their results intelligently used in 1857, was largely instrumental in the establishment in 1887 of an agricultural station in every state and territory. The educational stimulus of these stations has reacted on the agricultural community and informed the public at large, so that today there is no dearth of eager students in our agricultural colleges. These, with high standards and ample facilities, are now training every year thousands of able, ambitious men to meet most exacting professional requirements, not as teachers only, but largely as workers in the business world, producers of our national wealth. Surely a wonderful result in so short a period is this outcome of efforts in which Professor Johnson bore a sustained part.

When, in March 1877, the bill passed which established the Connecticut Agricultural Experiment Station as a State institution, many letters came from friends who had watched and sympathized with Professor Johnson's life work. On April 7, Mr. Luther H. Tucker wrote:

Accept my congratulations on the success of your efforts thus far and their prospect of usefulness in the future.

Mr. Goodale closed a letter of this period with the words:

I was rejoiced to learn from the papers that the Experiment Station is to go to New Haven and be under your direction. I trust there is no mistake about it. Tardy justice and right doing is better than postponement forever or till too late.

Professor Storer wrote:

Jamaica Plain, Mass., 19 Apr. 1877.

My dear Johnson:—I congratulate you most heartily! Occasionally as now, the Eternal Fitness of Things is vindicated, and it is a real pleasure to witness the event.

I have never had the least knowledge of the ins and outs of your Conn. Agric. politics, but have sworn some frequently at what seemed to be evidences that the Patriarch of our Sci. Agric. might probably be cheated out of his birthright and workright. Long ago I made a memorandum of questions to be asked of you concerning your attitude and position *in re* Agric. Station. . . .

Pray come on when you can—(and tell me among other things *why* you esteem maize grain to be “too nitrogenous” as you have said in *Amer. Jr. Sci.*). Yrs. sincerely,

F. H. Storer.

Immediately upon Professor Johnson's appointment as director, came a pleasant note from his old pupil and assistant, Dr. Jenkins:

Middletown, Conn., April 12, 1877.

My dear Professor:—I congratulate you, and the farmers of the State and myself too, that the Station has passed into your immediate control, where I have felt that it rightfully belonged from the first. I hope you will find its management a pleasure and not too great a burden. If the Board of Control and yourself conclude to ask me to assist in carrying out the work of the Station, please reckon on my heartiest interest and coöperation with all your plans. . . . Very sincerely yours,
E. H. Jenkins.

The modest equipment of the new institution and the helpful attitude of its friends appear in this note, written October 6, 1877, by Professor Johnson to a staunch supporter of the Station, who was also a dealer in horticultural supplies:

Would you kindly permit Mr. Jenkins to use a straw or stalk cutter in your store to reduce to short bits some samples of corn-fodder sent me by T. S. Gold, Sec'y-B'd of Ag., for analysis? Having on a former occasion been favored in this way, I am encouraged to ask again!

The letters of Professor Johnson which follow—with the exception of those written to Professor Storer, Dr. Jenkins, Dr. Britton and to the Commissioner of Agriculture—are taken from copy-books of the Connecticut Station. They are in Professor Johnson's own handwriting and are of interest either through their contents or because of the time at which they were written. They require little or no comment:

(S. W. J. to J. O.)

[October 10, 1877]—I regret to differ from yourself and from Mr. Lawes and Dr. Liebig on so important a subject [*the valuation of fertilizers*]. To me the whole subject appears to be very simple. The valuation merely touches the question of price in market, as far as that depends upon the *trade-value* of ingredients. If a fertilizer has or is thought to have a value beyond this, depending upon some secret of compounding, or established reputation, there is no objection to those who believe in such superiority paying for it, but for those who have no faith in, or do not care to pay for such advantages, the “valuation business” is a simple and safe guide to purchase by. Such is the record of twenty years in this State. Honest dealers do not complain of it, but support it heartily, because it stops the occupation of quacks and swindlers and establishes confidence between buyer and seller.

We use great care in securing samples that accurately represent the articles we investigate, and our analyses are invariably duplicated so that mistake is made well-nigh impossible. On the other hand our dealers and manufacturers (in the State) are very careful to know what they offer and to offer only that which sustains a good reputation. The valuation business would be of no use here were all the fertilizers, so-called, that come into our market made honestly and intelligently. The fact that parties destitute of one or both these standard virtues seek custom in this State renders the valuation business a necessity, and I believe that with us it is an advantage to all concerned. . . . Yours most truly,
S. W. Johnson.

(S. W. J. to — L.)

[October 10, 1877]—I am certain that although the valuation system may not always *have been* justly applied, it always *may be*, and that consumers cannot spare it.—

(A. S. to S. W. J.)

Verehrter obwohl noch ungesehener Freund! Am 15 Sept. v. J. wurde bei der 25 jährigen Feier der I Deutschen Versuchsstation zu Moeckern Wolff u. mir ein Album der internationalen Agriulturehemiker verehrt, wofür ich eben denselben durch meine alte Visage meinen Dank ausgesprochen habe. Auch Sie gehören zu diesen, daher werden Sie sich nicht weigern, ihr Herberge und Gastrecht in Ihrem Home zu gewähren; Dank Ihren oft wiederholten Reports über Ihre rüstige Thätigkeit bin ich wenigstens in Ihrem scientific and Berufs-Home zu Hause und verfolge das frische Leben Ihrer Conneetieut Agricultural Experiment Station mit lebhaftem und sympathischem Interesse. Möge Ihnen noch lange ein erfolgreiches Wirken auf diesem Felde beschieden sein! Das meinige naht sich dem Feierabende.

Mit aufrichtiger collegialischer Freundschaft

der Ihrige

A. Stoeckhardt.

Tharandt, 28. 3. 78

(F. H. S. to S. W. J.)

26 Apr. 1878.

Dear Johnson,—I schäme mich not a little that I haven't written long ago to commend your report and to acknowledge your note. . . . I noted (even before you wrote) what you say of Miller's cows vs. meal. 'Tis just what I would have said myself. I don't believe the beggar—any more than that there is some fire under the smoke—but he clearly has the "right of way," and we are bound to test his notion by fair and well intentioned exp.

I congratulate you on the team you have to drive in that Exp. Station. There are many things in the hierarchieal arrangement and the disbursing of salaries in your plan that I can't get along with, for they seem to me inconsistent with

the eternal fitness of things; but that you have a well manned ship under your feet is patent to all men.

Mrs. Storer sends her best wishes, and I am

yrs ever

F. H. Storer.

(S. W. J. to J. B. O.)

[*In regard to strawberry rust.*] August 21, 1878—Brewer agrees with me in the opinion that it is probably a fungus which attacks them, and if so, *we* are not competent to study it. Prof. W. G. Farlow of Cambridge, Mass., is the single person in the U. S. who is fully adequate to the investigation. I shall write to him by this mail to learn what he knows about it and what he can do about it.

(S. W. J. to W. G. F.)

Nov. 27th, 1878.

My dear Sir;—Yours of 25th is rec'd. Accept my thanks in behalf of our Agriculture for your kind service. . . . I find the fungus, now, described and figured in Sorauer's *Handbuch der Pflanzen Krankheiten*, but failed to find it there when Olcott first brought it to my notice, because the index does not contain the word *Erdbeere*. Very truly yours,
S. W. Johnson.

(S. W. J. to P. M. A.)

Feb'y 28th, 1879.

Dear Sir:—The cranberries are rec'd as well as your postal. I regret that I can see no way in which a chemical examination would be of service. The scald or blight is most probably a fungus, and the careful microscopic study of the fungus and cranberry at the bogs in summer by a skilled specialist is doubtless the way to follow in order to know and possibly circumvent the rot. Undoubtedly chemical analysis of the two lots sent would show differences. So would two samples of

either lot, if the large and small berries were examined separately. Therefore the differences that would appear would not of necessity stand connected with the rot, or at least would throw no light on the *cause* of the difficulty or its *remedy*. In no case to my knowledge has any plant-disease of the nature of a rot been found to be caused by a deficiency of some one or more elements in the soil or plant.

I will write to Dr. Farlow,—our best fungologist and perhaps almost the only American who has thoroughly studied microscopie fungi—to learn if he knows anything about the matter. Yours very truly,

S. W. Johnson.

(S. W. J. to W. E. P.)

July 7, 1879.

My dear Sir:—I have carefully read and considered the draft of a bill you sent me. From all I have been able to learn of the methods of fertilizer control adopted in Europe and this country, I am convinced that the system of Inspection is the one least advantageous to the honest farmers and dealers and most advantageous to the dishonest dealer and the stealing politicians.

I believe the Experiment Station system as we have it in Connecticut, *if actively supported by the farmers*, is the best in immediate results and is a system whose incidental benefits are of incalculable advantage.

I recommend you to stand by the Experiment Station and help it to become what it ought to be. I fear your scheme of replacing the Expt. Station by Inspection will work harm to the agriculture of your State. . . .

(S. W. J. to G. T.)

December 4, 1879.

. . . The Connecticut System does not *ensure* that no spurious or fraudulent fertilizers are sold or bought in the State, but it gives the farmers the means of ascertaining the composition and value of all fertilizers, feeding stuffs, etc.,

that are offered to them, without cost beyond the expense of taking and sending a sample. The frequent bulletins give wide publicity to the results of analyses, and the result is that fertilizers that are not commercially worth what they cost, or nearly so, are either entirely out of the Conn. market, or if they appear remain but a short time.

The *State Law* respecting fertilizers has, so far as I can learn, no effect beyond securing a label and "analysis" of some sort attached to each package of fertilizer. The law is not precise enough in its terms to be of any use otherwise, and no prosecutions or complaints have ever been made under it.

The *Exp. Station*, therefore, with the coöperation of a number of active farmers and Farmers' clubs, accomplishes whatever results we have, independently of any special legislation or inspection. Manufacturers in the State and many without who sell their wares here, so far as I know, are pleased with the operations of the Station; for, as they say, it practically excludes inferior goods from our markets, and secures an impartial verdict on the merits of each article sold. The Station makes no prosecution of the dealers in poor fertilizers, it simply *publishes* the character of their goods, and public opinion inflicts due punishment.

The cost of the Station as now carried on is \$5000 yearly. The rooms occupied by it are furnished rent-free by the S. S. School. The Station is simply a *chemical laboratory* and *correspondence office*. It now employs three chemists and a Director, has no grounds and no facilities for any but laboratory experiments. . . . Yours very truly, S. W. Johnson.

(S. W. J. to F. H. S.)

New Haven, Ct., Dec. 15th, 1879.

My dear Storer,— . . . I am most profoundly sorry at the state of Bussey in general and . . . in particular. As to the questions—I only know what I got or rather I know

nothing beyond that. I can't certainly say whether it was \$35. per column that I first worked for, for the *Tribune*, or not, but I think it was that. I struck for \$50. per column, had it for 6 mos, then declined to go on. That was large pay I suppose, for the paper, but my literary spigot has such a stricture that I couldn't dribble anyway for the press, in addition to my other work. I have no idea what C. gets. I don't know who shines in the N. Y. *Sun*. I now don't read or see the ag. columns of any of the N. Y. or other daily papers. I haven't strength or time.

The *Co. Gent.*, Albany, pays me \$5.00 per column and I have a sort of feeling that its column is not so consumptive, relatively, of MSS. as the *Tribune* *e. g.*, but I don't now recall the result of any close comparison. I think that *per column* is the usual mode of reckoning, and by that they mean as solid matter as they can get, generally.

I shall *at once* see if I can't suggest to some good parties that they *may* get you to write for their papers, etc. Yours most faithfully,

S. W. Johnson.

This letter of Professor Storer is an instance of early use of the typewriter.

Jamaica Plain, April 3, 1880.

My dear Johnson:—Behold how the virtuous man considereth the eyes of his friend and spelleth out his little sermon! To wit:—I have had a great deal of pleasure in reading your report, and I wish to bear the fact in upon you, and upon Drs. Jenkins and Armsby also. I wish you would make my compliments to both these gentlemen. Jenkins' list of fodder analyses and Armsby's article on amids are not only excellent in themselves, but they are *timely*. It isn't often that fate permits us to be thus instant in season.

Your question of American hay vs. European becomes interesting, does it not? I fancy we must look to *Botany* for its solution. You remember, I suppose, that some twenty years

ago, at a time of drought in England, one of the Steamship Cos. took American hay to fill up their ships, on their own speculation, and could only dispose of it at a heavy loss in London and Liverpool. The talk was then that our hay was too coarse to suit the English eye, but it looks now as if J. B.'s "prejudice" was not so dunderheaded as it then seemed. I have always wondered at the difference between the requirements of our hay markets and those of England. It is not so strange, perhaps, that coarse hay commands a higher price than fine here, so long as danthonia is abundant, but it is curious that we despise really good fine hay when the English will buy no other. Ten years ago I tried to get one of our agricultural societies to import merchantable samples of English hay to be exhibited at our cattle fairs, but nothing ever came of the idea.

By the way,—I speak with reservation since I have never seen the man,—but it did seem to me that you handle —— too gently; or rather that you pat him much too gently on the back. Thought needs to be given to the devising of methods of allaying the bumptiousness of some of our practical men—and I am clear that praise (no matter how damnably "faint" it may be) is not a means to this end. It needs to be shown that for successful research something more than good intentions is necessary; viz, technical training, modesty of thought, and an open mind.

I am glad you hold your "luff" in respect to the conventional method of stating analyses of fodder. There is no sense in trying to refine this thing beyond the possibly practical. We are hardly more ripe than Einhof and Sprengel were for the complete analysis of rough fodders, and there is a semblance of——(let us say ignorance) in holding up the names of too many chemicals to the gaze of the great and unsoaked public. It is bad enough to have to report the "fat" of hay as if it were really oil.

I am glad, too, to see you hold off from Kühn's reactionary

movement in the last Landwirth Kalender. There is something too absurd in his effort to stampede us, at this day and hour, into taking the back track. What we really need is a *critical sifting* of all the analyses with the view of discovering the best possible means, in the light of existing knowledge. The question is one of chemistry far more than of arithmetic. There are manifold instances of "maxima" and "minima" which could be thrown out at once, *for cause*. I see, for example, that Jenkins has roped in a Bussey analysis of *dead* fresh-meadow grass, in getting his average for swale hay. I wouldn't have done it. Nor would I have said (*i.e.* note on page 150) that swale hay contains 14.3 per cent of water. It might be even questioned whether my hand samples of *Carex* belong in this particular "addition," though they do show the composition of early cut hay and point to what is possible in practice.

On page 96, the line relating to "oxen at rest," dele the last dot, period, decimal point, or whatever you call it. It darkens counsel. The other misprint there concealed this one, according to "the simultaneous contrast of colors"?

I don't remember having expressed my gratitude for your kind offices in recommending me to Mr. Carman. If I didn't (or if I did) let me do so now. I find him extremely civil and disposed to squareness. Yours faithfully, F. H. Storer.

(S. W. J. to J. T. H.)

May 27th, 1880.

Dear Sir,—Your proposal for a convention of agricultural chemists to agree upon methods of fertilizer analysis for common use, is in my opinion a very timely suggestion and I am entirely in favor of it. As to time and place of meeting, would it not be well to make them co-incident with some gathering at which many of those interested would be likely to be present,—say the annual meeting of the Am. Association for the Advancement of Science, held at Boston or Cambridge in August?

I would like to add to the list you give: Prof. F. H. Storer, Bussey Institution, Jamaica Plain, Mass.; Dr. Ledoux, New York City; Dr. E. H. Jenkins, New Haven, Conn.; Dr. H. P. Armsby, New Haven, Conn.; Mr. A. T. Neale, chemist to the New Jersey Ag. Exp. Station—all experienced fertilizer analysts. The discussion of the subject would be more satisfactory if there were time beforehand for some experimental work. I have some investigations in progress which can hardly be complete early in July, but might be late in August. . . . I would add the names of Prof. G. C. Caldwell, Cornell University, Ithaca, New York; Prof. Albert Chester, Hamilton College, Clinton, Oneida Co., N. Y.; Prof. A. Aubert, Maine Ag. College, Orono, Me. Very truly yours, S. W. Johnson.

(S. W. J. TO PROFESSOR G. C. CALDWELL, DIRECTOR OF
CORNELL EXPERIMENT STATION.)

Sep. 10th, 1880.

My dear Caldwell,—Dr. Charles U. Shepard, Jr., suggests that a meeting of the members of the committee appointed at Boston, viz., yourself, himself, Collier and Atwater be held for between Sep. 15 and 30th. This would be very profitable no doubt, and I write to ask you if you could come to New Haven (where I will bed and board you) and at what time. If you *cannot* come, that fact will decide me what next best thing to do. I should like the meeting held nearer the 15th than the 30th, Dr. Shepard has to go to So. Car. soon after the 30th.

But if you can come any time between these dates, let me know. Yours most truly,

S. W. Johnson.

(S. W. J. TO PROFESSOR GEORGE H. COOK, DIRECTOR OF
NEW JERSEY EXPERIMENT STATION.)

December 27th, 1880.

My dear Sir,—It has been repeatedly on my mind that some conference in respect to trade-values of fertilizers is desir-

able. I have, however, not found the occasion and having always to work in haste, have come this year to write and *print* my revision of trade-values without conference with others. I enclose you *printer's proof* of my conclusions from experience of 1880. . . . Please communicate your ideas as to my conclusions. Doubtless with more data I should be led to different results, although I believe that my conclusions are substantially correct and will be justified by the future as they have been by the past year's facts! Yours very truly,
S. W. Johnson.

I had nearly forgotten to recur to the subject of a *meeting* or of *correspondence* with Dr. Goessmann and some one in Pa.—For me it is, I fear, too late this year, as I must give the printer my final *revise* in a very few days.

(S. W. J. to C. L. D.)

Feb. 21, 1881.

Dear Sir,—I first learned, incidentally, on Saturday last that the bill to which you refer was before the Legislature. My first impressions are unfavorable to that sort of Legislation; if, however, adjacent States toll Conn. manufacturers, it is in the nature of self-defence to reciprocate. I would be glad of increase of Exp. Station Funds by any legitimate method that meets the approbation of farmers and dealers in the State. The proposed tax has this equitable feature that it makes, or tends to make, those who use fertilizers pay for the cost of having them suitably analyzed and thus kept reasonable in price and of genuine and known quality. I will be glad to appear before the committee. Yours, etc.

S. W. Johnson.

In a letter of May 5, 1881, Professor Johnson, again referring to this fertilizer law, said:

Its adoption in this State was the result of a move on the part of some of our fertilizer manufacturers, and was strongly supported by some of the leading firms engaged in this State

in making and selling this class of goods. The object of the law is to prevent the sale in the State of fraudulent or adulterated fertilizers, by requiring all who make or import (from foreign countries) to put themselves, their agents and their wares on record. *Farmers* in and out of the Legislature favored the Act because its result has been elsewhere, and must be here, to diminish the chances of their wasting their money on inferior or worthless fertilizers. *Manufacturers and dealers* favored it because the exclusion of worthless or adulterated goods settles the market, establishes the confidence of purchasers and thus benefits business.

(S. W. J. to N. M. C.)

Dec. 6, 1881.

Dear Sir,—It is a difficult question you have put me—very much like asking the cost of going to housekeeping! The list of apparatus and its cost—the kind and scale of laboratory fixtures and arrangements—will depend entirely on the lines of research that it is proposed to undertake and on the working force it is intended to employ. The chemist who is to direct the work alone can foresee what will be wanted after he has carefully considered what branches of investigation shall be attempted.

The total outfit of the laboratory of this Station could probably be replaced for \$2000. But if our means warranted undertaking research in any generous sense \$2000 could profitably be spent in the arrangements for studying each of many simple problems that are awaiting solution. Yours very truly,
S. W. Johnson.

(S. W. J. TO DR. C. A. GOESSMANN, PROFESSOR OF CHEMISTRY
IN MASSACHUSETTS AGRICULTURAL COLLEGE, AND DIRECTOR
OF MASSACHUSETTS EXPERIMENT STATION.)

Jan. 6th, 1882.

My dear Sir,—Dr. Cook and I would like to agree with you on a scale of prices to use in valuing commercial fertilizers

for the current year and future years. Boston, New York and Philadelphia cannot differ much, and Mass., Conn. and N. J. would probably be equally well served by a uniform scale. What do you say to it? And when could we have a meeting or exchange proposals so as to meet the spring trade?

(E. W. HILGARD, PROFESSOR OF AGRIC. CHEMISTRY IN THE UNIVERSITY OF CALIFORNIA, AND DIRECTOR OF THE EXPERIMENT STATION AT BERKELEY, TO S. W. J.)

Berkeley, March 10, 1882.

My dear Sir,—I have rec'd, and read with intense relish, your Experiment Station Report for 1881. You have done a wonderful amount of work with your \$5000; but it makes one almost have the mad-itch to think of this pittance allotted to such work as this, when millions are wasted, and worse than wasted, in merely bolstering up old and new political haeks, every year. I am beginning to feel aggressive on the subject, and have put some of that feeling into an article that will shortly appear in the *Atlantic*. If something of a breeze can be raised on that basis, by a concerted movement on the part of the Agr. College and Exp't Station men and their appreciators, we all may be enabled to work to some advantage, instead of gnawing our lips in disgust.

I have been forcibly struck with the contrast between the line of work that is asked of you and that which comes to me—it is exceedingly characteristic of the respective stages of agr. development in the two regions, and curiously illustrative of the wisdom of our worthy commissioner at Washington, when he proposes to send some one to Europe to find out what lines of ex. work ought to be done in experiment stations! *Quousque tandem*—?

I hope Sturtevant will make good use of his opportunities—if he does what I expect of him, it will give a great lift to all of us who are struggling to be enabled to do something!

When are you going to write that Vol. III—"How Crops should be fed." The subject of manures is among the most misty in the farmers' minds, and I wish you would save me the trouble of writing it up myself! Yours sincerely,

E. W. Hilgard.

(S. W. J. TO SEC. N. Y. STATE AG. SOC.)

Feb. 14, 1883.

My dear Sir:—The N. J. Station and the State Inspector of Fertilizers of Mass. joined with this Station last year in adopting a scale of prices. Our meeting was held in Jan. and we could not of course predict the very considerable fall in price of nitrogen that was to occur, but, as stated on p. 23 of report for 1882, we keep the values fixed throughout the year for the sake of comparing the different fertilizers. The average retail prices during the year for nitrogen were—in nitrates 3 cts, for organic nitrogen 2 cts, and for sol. phos. acid 1 ct, per lb. less than our estimated prices. Most of the material bought by farmers in the spring of 1882 was already manufactured or the stock thereof laid in during the fall or winter before, and the decline was slow in affecting the retail market.

There will always be plenty of small reasons against fixing an estimated price upon fertilizers, but there will always [*be*] a preponderance of large reasons why it should be done in the interests of consumers. Yours very truly,

S. W. Johnson.

(S. W. J. TO G. H. C.)

Feb. 16, 1883.

My dear Sir,—Yours in relation to meeting to decide upon fertilizer prices is at hand. It was in my mind to confer with you on the matter about these days. I have been rather desirous to place the time as late as will do for two reasons: 1, that we may get as near the state of the spring markets as possible so as not to find our reckoning "left" by a change in the markets. 2, in order to have the Station as far ad-

vanced as may be in its laboratory arrangements at the time of meeting, as I propose to entertain the delegations.

We have named March 1st as the date for opening our new Laboratory, and we shall *begin to open* on or before that day although some of our arrangements will not then be complete. If early enough, I should prefer to put the meeting on March 4th, as Saturday will, I suppose, suit Dr. Goessmann. Your season opens earlier than ours, and I prefer you would name the day, whether in Feb'y or later, as appears best to you. Yours very truly, S. W. Johnson.

I am in favor of inviting Dr. Ford of Ohio, Sec'y Chamberlain's chemist.

(S. W. J. to H. S.)

Mar. 23, 1883.

My dear Sir,—I rec'd your letter of the 20th and was summoned to Hartford the 21st to talk with the Ag. Committee. I was obliged to say there that I saw no *simple* and safe way to carry out a stamp or tag law. I would gladly favor an efficient law on that system, but don't feel that I can develop or frame one in detail.

The Committee was not in full force and I cannot say what their conclusions were, but I judged they favored no change for 1883. If you can specify the details of a law, they and I would be glad to have you do so. Yours very truly,

S. W. Johnson.

(S. W. J. to J. W. A.)

March 24, 1883.

My dear Sir,—I enclose Mr. Sedgewick's letter which you sent to me. I have written him that I am unable to shape a law, based on ton tax, that shall be simple and efficient, but shall be glad to favor one if it can be suggested. It appears to me that in any case the present law ought to be left un-

touched for a year. I believe that opposition to it will cease.

I omitted to say to you, as I intended, that we interpret the present law in the underscored passage in the most liberal manner possible, viz., ten dollars each for *nitrogen*, *phos. acid* and *potash* irrespective of the state or condition in which they may be present. This makes \$30 the highest charge possible. That ought to satisfy the "special fertilizer" people. Yours very truly, S. W. Johnson.

"more than ten dollars per ton, shall pay, etc. etc. an analysis fee of *ten dollars for each of the fertilizing ingredients* contained or claimed" etc.

(S. W. J. TO C. W. DABNEY, JR., DIRECTOR NORTH CAROLINA EXPERIMENT STATION.)

October 6, 1883.

My dear Sir,—I cannot see why the time is not at hand when a journal such as you propose may not be undertaken with reasonable prospects of success. Your outline of its scope, etc., is to my mind. I think it, however, of the intensest importance that it have an *Editor*, that some *one* who has both science and common sense shall be responsible for the matter and the manner of its contents. Otherwise, it will be likely to be given over to *slop* and *padding*, the two prominent ingredients in American literature. The several departments might be separately edited, but it ought to be an *organism* and not a *pudding*. In our stage of Ag. Expt. there is need of a moderately large amount of judicious criticism, and for that an Editor or *Editors* are needed.

Vast good would be accomplished by abundant abstracts of valuable papers published abroad, and I for one should not hesitate to "direct" the force under my charge to assist in work of that sort, feeling that such use of State funds would be for the highest possible good. Yours, etc.,

S. W. Johnson.

(S. W. J. to J. W. A.)

Nov. 17, 1883.

My dear Sir,—I have been hoping to hear from Mr. Sedgewick before writing to you. I have also been exceedingly busy getting our new laboratory ready for the fertilizer work that is coming in, and have had little opportunity to think about the fertilizer Law.

The tag or stamp system I see no way of carrying out except by appointing Inspectors and making a cumbersome and costly machinery. I hear it intimated from creditable sources that in Georgia the Inspection is suspected of not being altogether above bribery, but I know nothing as to the facts. The more complicated any system is made the more chances perhaps of its being dishonestly administered. The Pennsylvania system, viz.—taxing per ton sold, is simple, but the only evidence of sales is the sworn statement of the manufacturer or dealer. That, it strikes me, is offering a premium to dishonesty, and I should expect that dishonesty would get the premium!

See'y Chamberlain of Ohio writes me that the plan there in use works well and satisfies everybody. In Ohio the annual tax is \$20, here it is \$10, \$20, or \$30 according to whether one, two or three ingredients (nitrogen, phos. acid and potash) are present in the goods.

Our present law is disliked by two classes, viz., the small manufacturer and the maker of a large number of special brands. As to the latter, I have heard it asserted by those who claim to have been in the business, that orders for many different "specials" are filled from the same heap, care being taken that the Exp. Station shall be provided with carefully compounded samples. This may be a libel, but it also may be true! Our present law tends to check the multiplication of brands or pretended brands, to reduce the work to be done by the Station, and to suppress the nonsense employed to humbug farmers.

How to relieve small dealers?—It might be enacted that Grinders of Bones in Connecticut, instead of paying \$20 analysis fee, should at option pay 50 cts. per ton for product sold, *provided they could satisfy the Board of Control* (or Executive Committee) of the Station as to the amount of their sales. But making exceptions is troublesome business. I should not favor any exceptions but for *grinding Bone*. Making superphosphate on a small scale cannot be done so cheaply, nor so well as on a large,—and after all the many *farmers* and not the *FEW small manufacturers* are principally to be considered.

The present law is very highly spoken of by all with whom I have conversed whose interests are those of *consumers* of fertilizers. I will send or bring you very soon suggestions for amending the present law. Yours very truly,

S. W. Johnson.

(S. W. J. to J. J. W.)

May 8th, 1884.

My dear Sir,—Prof. Brewer and Dr. Jenkins think I ought to go next week to Atlanta, Ga., to attend a *convention* called by the Commissioner of Agriculture of Georgia to discuss methods of determining “Reverted Phosphoric Acid.” There is a very unhappy muddle in this matter already and, with your approval, I will prepare to go and see what can be done to prevent things from getting still more mixed. Yours,

S. W. Johnson.

(S. W. J. to R. B. W.)

June 3d, 1884.

Dear Sir,—In answer to yours of May 26th duly received, would say that when the minutes of convention at Atlanta are printed, the committee will elaborate plan of investigation and notify the gentlemen willing to participate, yourself among the rest.

As to soil analyses, I am so blind as not to be able to see much benefit in them as usually made. If you can find a half dozen soils, more or less, which evidence a graded productiveness, and can show any positive relations between composition and fertility, that would [be] a valuable result. My friend Dr. E. W. Hilgard's methods (1st Census Report on Cotton Production of U. S.) appear to be most promising. Dr. G. E. Moore's plan of mechanical analysis (see 10th Census Report on Tobacco culture) is worthy of investigation. I have long desired to do something in soil analysis but have not yet been able to undertake any systematic and extended work. What to do and where to stop in soil analysis are very perplexing questions. Yours very truly, S. W. Johnson.

(S. W. J. to A. D. G.)

March 27th, 1886.

Dear Sir,—In answer to yours of yesterday, I believe it would be a great gain were: All our States to adopt one uniform Fertilizer Law; were all samples for official analysis taken by honest experts; were all analyses made by uniform (if good) methods. I also believe—that Experiment Stations and Departments of Agriculture are more properly supported by a general tax than by a special tax on manufacture of fertilizers.

There are, however, two sides to all these questions. To illustrate:—

1. The laws that now appear to work well in Georgia and North Carolina would not apply in Connecticut.

2. The detriment caused by the imperfect sampling of honest men or by the "cooked" samples of an occasional rogue would be offset by danger of systematic fraud by corrupt experts.

3. Uniformity in methods of analysis is no remedy for bad methods or unskilful use of good ones.

4. That all manufacturers of Fertilizers do not, or have not, regarded the exaction from them of a tax as oppressive or unjust would appear from the facts that the first legislation of that kind in this State originated with a manufacturer of fertilizers, and that fertilizer makers and dealers urged the passage of the present law on the ground that it would give steady occupation to honest manufacturers while, otherwise, the frauds practised upon and feared by farmers tended to unsettle the business. Yours very truly, S. W. Johnson.

(S. W. J. TO F. H. S., ACKNOWLEDGING THE RECEIPT OF A NEW EDITION OF STORER'S "AGRICULTURE.")

New Haven, Conn., Mar. 26, 1887.

My dear Storer,—The book followed close on your note of 20th inst., and has infatuated me even as a love story temporarily (or permanently) crazes a damozel. I found it on returning from a two days attendance on the law-making power at Hartford, and though nearly tired out I sat up o' nights over it—at first reading some 100 pages with due consideration, then as the fire got low and the head hot I skimmed the pages—taking cold and waking up next morning with congestion of the two valuable viscerae that secrete bile and thought, from which I am happily recovered. Well, the plot of the story pleases me and the details are worked up in capital shape. I feel relieved by your book of a heavy sense of unread and undigested literature—judicial decisions on natural law—that needed codifying—I have the code now in good shape!

To our ag. schools the book will be of the utmost value, and the Exp. St. boom that is expected from the Hatch bill will find within its covers both stimulant and tonic for the sober workers, while those that have more zeal than sense will find it healthfully sedative, it is to be hoped.

The only drawback I find is that I can't praise the work

to my friends or think of the preface without fearing that you have over-estimated the performance of—Yours most humbly,
S. W. Johnson.

(PRESIDENT ATHERTON OF STATE COLLEGE, PENNSYLVANIA, TO
S. W. J.)

State College, Centre Co., Pa. 9/16/1887.

My dear Sir,—You will see from the enclosed circular that we are hoping for your presence at the Washington Convention, and I beg to repeat what I have already indicated, that your inability, for any reason, to do so, will be a great disappointment to us all. The stage now reached in Agricultural Science seems to me extremely critical and hopeful. Wise counsels now may do much to coördinate and, at the same time, inspire the work of investigation, throughout the entire country; and we must look to you and other leaders in this field, to give those counsels. I hope you will find it possible to be present. If that should be out of the question, will you not try to send a paper, even if only a short one. Faithfully
yrs,
Geo. W. Atherton.

Professor Johnson, with collaboration of others, prepared a list of books for station libraries, which is referred to in the correspondence and was published by the Department of Agriculture.

(G. H. C. to S. W. J.)

New Brunswick, N. J., Dec. 22, 1887.

My dear Sir,— . . . All that I have heard from are looking with interest for your list of ag. books. It must be a work of considerable extent, and rather drudgery at that. If you choose to get [*an*] amanuensis or some librarian who is used to cataloguing books to help you in the work, I shall be glad to help in seeing that the expense is paid. Hoping to see you next week, I remain, Yours truly,
Geo. H. Cook.

(F. H. S. to S. W. J.)

182 Boylston St., Boston, 5 Jan. 1888.

Dear Johnson,—I submit a list for you to rend and tear. Kick 'em out—fire them out (as the moderns say)—at your sweet will. I have no feelings about them at all. One trouble is that I don't know just what kind of an *altitude* you have thrown your mind into. I think your list is an excellent one—and of course you wish to keep within reasonable limits—but I know that I wouldn't have voted for several of the titles of your list and this fact emboldens me to make a longer list than I would have done otherwise. I say, for example, "the last edition of Mulder is a far worthier book than 'Colman'"—and so I write down Pierre! Anyway, I have struck out many titles which I put down on a first rough list. I would have been inclined *e.g.* to name several of the German Journals of Physiology and books like Dana's and LeConte's "Geologies" and MacFarlane's "Geologist's Travelling Handbook" and Watt's "Dict. Chem." Likewise some of the works of the agricultural fathers, such as Thaer, Scheele and Black.

By the way, I have been wishing to say all summer how much I was gratified by the notice of "Storer's Agric." in *Science*. I have felt in my bones all along that this notice was written or "*inspired*" by S. W. Johnson! and I had thought that I could soon find out about it and so openly thank him. Inasmuch as I haven't been able thus far to learn who did write it, you will allow me to slop over sufficiently to say that, whoever the artist was who drew the picture, I did and do keenly appreciate the delicate shading which he put into it. He started out with his pen much too full of ink, but when he got to talking of the "difficulties of the subject" and of "familiarity with the *conditions* of practice" (where a tinker would have said familiarity with practice), I perceived the hand of a master and was elated and "sot up."

N. B. You must send me a copy of the completed list!!
Sincerely yours, F. H. Storer.

(S. W. J. to F. H. S.)

New Haven, Ct., Jan. 13, 1888.

My dear Storer,—I became duly possessed of your sending of the 5th inst., and but for a heavy job of examination papers, Station Report, proofs and other jobs of writing should have thrown the arms of my soul around the neck of yours and cried—evoe! ahoy! prosit! na! or something in a “furrin” tongue (badly spelled doubtless!) to express my delight in such an east wind as your letter brought me from *Bos*-town. I have put your titles all into my catalogue—a good number of them were booked for it but had failed to get copied, but a good number I owe to your suggestion.

The *Science* review of your “Agriculture” I did not write nor do I positively know who did. I suppose it was Armsby. I recommended him to *Science* to do their ag. Sciencee for them and he has a good head on him. Has just gone to direct the Pa. State Ag. Exp. Station.

I had thought I might run on to Boston and see you during the late holiday vacation—but “business” piled up and I had to maintain the awful grind.

When you have an odd day and want a change, come and stay with me at 54 Trumbull St. My wife and I, having married off our little girl, are keeping house with Hanna Anderson and the eat, and can keep you as snug and quiet as could be desired. Yours faithfully, S. W. Johnson.

The wife says she would like to show you her *grandson* who lords it over another ward of this city.

(ORIGINAL DRAFT OF LETTER OF S. W. J. TO THE U. S. COMMISSIONER OF AGRICULTURE.)

New Haven, Conn., Feb. 7, 1888.

My dear Sir,—In reference to your proposition to eliminate or materially modify Prof. Comstock’s list of books by submitting it to revision by the Entomological Division of the

U. S. Dept. of Ag., I have only to say that I have no objection to any treatment of that list which Prof. Comstock will assent to. It is his list, contributed in response to my request. He must be consulted in regard to any *modification* of it.

I think I fully appreciate the situation—the issuing of the List under the auspices and in the name of the Department—but I see clearly that any course of logic that leads to the conclusion that the entomological list should be submitted to the Department-Entomologist for the oil of his consecration applies with equal force to the chemical, botanical and other lists which I have taken the trouble to prepare; and whose publication by the Department is just as proper or improper as that of the entomological list. But I do not think that half as much fault will be found with the printing of Prof. Comstock's list as would be with any modification or suppression of it. I was asked to prepare the list not because I am the one best able to do that work, but because at the juncture I happened to be available. My name on that list and the names of those whom I have credited as collaborators imply no lack of ability on the part of the Department officers to do that job. Prof. Riley and his associates cannot reasonably be expected to do all the entomological, nor Prof. Wiley and his associates all the chemical work that is urgently needed in this country. If any difficulty remains in your mind about printing the list as it stands, please return it to me. I will print it as a Bulletin of this Station under the Hatch Bill.

Yours very truly, S. W. Johnson.

(S. W. J. to F. H. S.)

New Haven, Conn., Oct. 13, 1888.

My dear Storer,—Prof. Atwater has an appointment from the U. S. Dept. of Agr. to take charge of some work anent Exp. Stations and will soon call on you and explain it, and ask your friendly advice and coöperation. I have promised to help him as far as I am able, and I hope you may have time

and will to hear him patiently and to give him your support actively.

We latter-day Pharisees may have nearly come to the conclusion that nothing good can come out of Washington Nazareth, but the Voice crying in the Wilderness has not been altogether unheard and the "convention" last year seemed to me like a sort of star-led congress, a pilgrimage of the Magi and of the prophets and seers, and [if] the wise men of the East will lend a hand—may we not see the Hand of the Lord and have opened to us the way of salvation? I write in parable if not hyperbole, yet reverently and with fear and trembling lest with such signs and wonders in the heavens I should be found unworthy to come up to the temple—because of unbelief and hardness of heart!

I have, with others, favored Prof. Atwater's appointment because he has the spirit of prophecy and appears to me to be a chosen vessel. Doubtless you and I, could we undertake everything, would do many things very differently from what he would, but with his diversity of gifts he has the same spirit and a splendid stock of muscle too, very essential, which some of us have not. I shall pray for him when he enters the lion's den, and may the Highest deliver him and build him up. This script is not only to bespeak your favorable interest in Atwater's mission, but to say good morrow and God-speed to yourself.

Enjoyed Prof. J. P. Cooke and Mrs. Cooke's very pleasant countenances for 3 weeks at Holderness, New Hampshire, in July and August last. Ask them about that loveliest of places! Yours,

S. W. Johnson.

In 1890, Professor Johnson published a new edition of "How Crops Grow." Without his knowledge, his portrait was included in the volume. He had consented to the reproduction of his photograph in the columns of an agricultural journal; the possibility of this permission being extended without his sanction

to cover the book did not occur to him. A saving sense of humor enabled him to meet this annoyance, to which we owe several of the letters that follow:

(DR. PETER COLLIER, DIRECTOR OF NEW YORK EXPERIMENT STATION, TO S. W. J.)

Geneva, N. Y., Feby. 2nd, 1890.

My dear Professor Johnson, I come for two favors—I'm always coming. 1st I wish a copy of "your book," as Liebig called it, and your name sending it to one of your first-born (I speak of Agriculture) and your most loving disciple. I will gladly send for it to publishers, but I wish it from you. I'm good for it. 2nd I wish you would consult with Brewer and tell me of any good available men in *any* branch of agricultural science. Afftly yours, Peter Collier.

(F. H. S. TO S. W. J.)

182 Boylston St., Boston, 10 April 1890.

Dear Johnson,—Hail! Hail!!—which is in no sense to be translated Alle Hagel. Likewise the countenance of him!!! which reminds me of Francis Parkman, Historian and Horticulturist.

After I have done myself the pleasure and profit of reading the book I will write to you a note of veritable thanks. These present lines are to acknowledge the reception of the new edition of "H. C. G." and to congratulate the author as for a man-child born again. Sincerely yours, F. H. Storer.

(S. W. J. TO F. H. S.)

New Haven, Conn., Apr. 12th, 1890.

My dear Storer,—I thought that *countenance* would draw your fire. Well *can* you imagine that any body but a live Yankee, and a Massachusetts man at that, should, would, or

could make and put as frontispiece in another man's book such a portrait, or any portrait of anybody, without the author's consent or knowledge? That's the state of the case, and after having that book concealed on my premises for weeks, trying to make up my mind whether I should drink hemlock or fire an explosive bullet into the carcass of my enemy, I concluded I would fire the book at my friends and take what fun there may be left in this life in looking on while they wonder at the altitudes and profundities of an author's vanity!

In a few copies I have sent over the sea I have carefully excised that ornamental feature, for thus saith the Scripture "If thy right hand offend thee" &c, but in this free country I conclude to face the music and 'tend to my business. When I read in the *Country Gentleman* that "the present edition is adorned with the portrait of the author," I said to myself—there's one true friend! but what an ass he must conclude I have grown to be!!

Well the book will serve my classes of 1 to 4 students, and as I grow old and ugly they may derive some pleasure at the thought that they are not the only fellows who like caricatures. I send you the two photos, which I sent the publisher to insert in his "*paper*," and stop his importunity. Yours with much love,

S. W. Johnson.

(F. H. S. to S. W. J.)

Boston 20 April 1890.

Dear Johnson,—I am very glad to have the photos, which do most certainly much better represent than does the frontispiece the man as I have known him. I do not wonder that your wrath was within you stirred both as to the matter and the manner of your taking off. And yet, do you know? That picture in the book is not wholly to be deprecated. Unlike, it is no doubt in many respects,—because inadequate; and in some points perhaps it is displeasing because forsooth we

naturally wish to have a portrait truly represent its principal, but it is not of the nature for caricature—not in the least! It is a strong, resolute, intellectual face with chin and nose and forehead very much *comme il faut*. All the trouble is that the sensitized plate happened to catch such a strong impression of brain and jaw, as emanations from these weighty organs impinged upon it, that no sufficient room was left for the depiction of certain delicate traits which would have imparted the natural and proper flavor of *Gemüthlichkeit*.

I wish I could send you photographs of my own personality. I haven't had any in my possession for something like 30 years, and I am too much in the dumps at the present moment to think of being "taken."

I have been reading the new H. C. G. with no small amount of satisfaction and am now more than ever anxious to see a new edition of H. C. F., with which volume as it happens I am personally in much closer sympathy than with the one now in hand. Not that I don't love this one, but that I love the other more.

Mentally, I care but little for gardening or horticulture. For farming, on the contrary, I am keen. Unlike yourself, I have never been much attracted by botany, or morpholôgy or by vegetable physiology (as she is taught),—all of which is very wrong of me and base—as I well know. But when you get upon topics where chemistry can be "applied," you may be sure of one attentive auditor. I am much struck in the new vol. by your loyalty to high science—so to say. And therein you are wise. You hold yourself and your reader well up above any low or "temporary" point of view. Most of us, perhaps, are only too ready to talk down towards the level of the "practical man," and in all probability little or nothing is gained by our doing so.

Of course there are a dozen things I would like to talk with you about. For example "avenine." Manifestly the French-

man evolved it out of consciousness. But the practical workaday fact remains true that oats do "excite" horses, while maize does not. How horrid to be torn from moorings and driven upon the deep tempestuous sea!! Sincerely yours,

F. H. Storer.

(E. W. H. to S. W. J.)

Berkeley, May 8, 1890.

My dear Sir,—I have to thank you for a copy of the new edition of "How Crops Grow," the receipt of which would have been acknowledged much sooner had I not been peremptorily kept with "the nose to the grindstone" in the preparation of MS. for the State printer, so as to make even a cursory perusal of the book difficult, much less an "eingehende Betrachtung," as they say in Germany. But right at first I was pleasantly surprised by the view of your pleasant countenance as a frontispiece—reminding me, by the slight change in the fifteen years that have elapsed since we met, that the days flow by calmly in the city of elms; while *here* the proverbial restlessness and hurry of American life reaches its maximum and makes its mark on us. In fact, I often repeat mentally the pregnant remark of the Badenser forty-niner: "Wann's noch lang so fortgeht, geht's nimmer lang so fort!" And yet it seems impossible to stop without having the Jugernaut of public expectations and demands run clean over one.

Now as for the book, I greet it with empressement; for in using it ever since I emigrated from Michigan, I have every year had to add more to the text, until the students felt aggrieved at my not sticking closer to the book. That is all right now, and more so, for you have given in compendious forms some matters that I had not been able to get into shape to my satisfaction, even in my own head. In looking over your text on the albuminoids, I begin to regret the good olden time when we knew so much more definitely about these

things than we do now! And what if Hammond's cobra-poison albuminoid should turn out to be a fact?—But one question in that connection: Why do you omit animal glue from your enumeration? My students have asked me that question repeatedly. Ever yours truly, E. W. Hilgard.

(J. B. L. to S. W. J.)

Rothamsted, St. Albans, April 28, 1890.

My dear Sir,— . . . Your books have been of great service to myself as well as to all students in agriculture. This science is occupying a great many more people's attention than was the case when I first began my experiments and it would appear that your countrymen will before very long occupy a very prominent place in agricultural investigation. Believe me, Sincerely yours, J. B. Lawes.

(S. W. J. to F. H. S.)

New Haven, Ct., May 10th, 1890.

Dear Storer,—Apropos of "avenin" of Sanson—I wrote somewhat wrong in stating H. C. G. (1890) p. 121, that Osborne was not "able to find any evidence of the presence of such a body in oats." He did find "a brown, granular, non-cryst. substance." He did not find a substance of alkaloidal character. Sanson's evidence of "alkaloidal character" was derived from its action on the nerve-system, and his view was apparently confirmed by finding a large content of nitrogen.

The body Osborne got was undoubtedly an albuminoid as that *Sammelwort* is now understood. Since all that in H. C. G. was printed, S. Martin (Berliner Berichte XXII—770 *e* from Proc. Roy. Soc. 46 100-108) asserts that the *albumose* of the "prayer bean," *Abrus precatorius*, is a poison *deadly* in doses of 0.060 gm. per kilo of animal live weight when administered in aqueous solution by subcutaneous injection. Martin says the poison-symptoms are the same as those produced by

globulin (whereof I know not), and, further, he holds the abrus-poison similar to that of Schlangengift in composition and action.

If Martin be right—and he appears to be a God-fearing and truly chemical biologist—then Sanson and you may be also right in holding that oats have an alkaloidal or quasi-alkaloidal action on the nervous system although avenin is not a derivative of pyridine or quinoline. Yours most faithfully,

S. W. Johnson.

P. S.—My former colleague, Wm. A. Norton, engineer and astronomer—now 5 yrs. at rest—used to aver that he could not eat oatmeal—“it excited him so!” I could never find it made any special impression on my Rückenmark or any of its Verzweigungen—but then I am not one of Reichenbaeh’s “sensitive Menschen.”

(F. H. S. TO S. W. J.)

182 Boylston St., Boston, 12 May, 1890.

Dear Johnson,—You bring to mind a point which has often bothered me. The English have a proverbial expression which has made many an American lady look aghast. In speaking of a bumptious youth, they are apt to say “He is full of beans.” This expression has passed from the stable to the parlor precisely like our “He feels his oats,” of which it is practically the equivalent. A knowledge of this expression has occasionally shaken my faith in the “excitement in oats”; but then comes our daily contrast of oats and maize and the absent horse-bean is out of mind and “has” of course “toujours tort.” If there is an exciting albuminoid such as you tell of it will compose matters not a little.

By the way, there was an English chemist here last winter, W. Maxwell, who had much to say of Cholin. He looked up the practices of our housewives, and learned that it is customary in these parts to soak the “Boston bean” before cooking it and to throw away the cholinated water!

That is an interesting tale, too, which you tell of Prof. Norton's excitement from oatmeal. I had never thought of the possibility of such human excitation. Tons of the stuff have I eaten—and, as you well know, milder mannered man did never cut a throat; albeit a "drop" of coffee or of tea will most surely keep me awake for hours at night. But then you know how Ninon—as Dr. Holmes narrates—told of her being intoxicated by a beefsteak once—during convalescence. Sincerely yours, F. H. Storer.

One thing to be tried would be to see if horses are excited by cooked oats. Is Armsby so situated that he could try this exp.? It would be of value to verify Sanson's "electrical" tests, anyway.

Perhaps Sanson tried the effect of heat on his avenin?

I am afar from books, as I write, but I remain as usual

Thine—

(S. W. J. to S. P.)

Nov. 4—1890.

My dear Parsons,—Some months ago I had it on my mind to write you that I was going to come down to Gotham with my friend Olcott, and talk grass. Olcott has been working on that subject for some years, and is on the track of some very positive improvements in that line, we think here. You are situated very favorably to aid in developing and publishing his plans and results and I knew would appreciate his good points better than any one I know.

Well I didn't get so far as to write or go, and for good reasons, viz.—too much to do. In the meantime Olcott—who is enterprising—has interviewed you, and hopes to get opportunity to show his faith by his works under your eye and auspices. I told him last week that tomorrow—weather being favorable—I would join him on an *outing* to Central Park, and try with him to see you for a few minutes.

This Station is assisting him and being assisted by him, and we are very desirous to add to our experimental plots, prom-

ising grass-varieties, for lawn or grazing and are glad to have his field of observation extended. So if we, or Oleott alone, should turn up at your office soon, it will be mainly for the grass business. Yours very truly, S. W. Johnson.

(S. W. J. to A. S. C.)

Dec. 26, 1891.

Dear Sir,—In answer to yours of 21st, I may say that the “Fertilizer Law” of this State *requires this Station* to analyze every Fertilizer sold, offered or exposed for sale in this State, costing \$10 or more per ton and to publish an Annual Report; the U. S. Law requires us to publish 4 Bulletins annually, so that we can’t help advertising the manufacturers of Commercial Manures. Our other duties are definitely laid down in the law, and if we do them we have neither time nor means to use for holding meetings or carrying on the very useful and much needed work you refer to. The Board of Agriculture or the State Agricultural Society are the proper State organizations to hold agricultural meetings, and they are doing, I suppose, what they can with very small funds. It is a pity that so many of the most enterprising of those born and brought up to early manhood in this State should have gone all over the West and South to “make things lively” there, while so many of “the other sort” are letting things go to the dogs at home.

I shall send your letter to Sec’y T. S. Gold of West Cornwall—of the Board of Agriculture—so that he may know there is a live farmer in Canton who wants to help “stir up the dry bones,” and if he or any other organizer wants my help it will be forthcoming. Yours very truly, S. W. Johnson.

(S. W. J. to F. H. S.)

28th March, 1892.

My dear Storer,—Accept my best thanks for the copy of “Agriculture.” I am glad to see “4th edition” on the title

page. The chapter on Symbiosis is capital. I laid aside my novel to read it. I was away from home last week or should have more promptly acknowledged receipt of your postal and the books. . . . I send you by this mail 2 copies of a study of the "Proteids of Zea Mays Kernel." Yours faithfully,
S. W. J.

(S. W. J. to J. G. S.)

Feb. 16, 1894.

Dear Sir,—In answer to yours of 13th inst., I would state that the U. S. appropriation under Act of 1887 is in this State equally divided between the Connecticut Ag. Exp. Station at New Haven and the Storrs Station at Storrs.

As to my opinion regarding the division of the fund, I should say that the entire annual appropriation is not enough of itself to carry on a first class Station; and to divide it would be detrimental to the best interests of all concerned, unless by such division the services of men or institutions could be secured which would compensate for the disadvantages of duplicating equipments, directors, experts and servants.

I do not doubt that at present the State of Connecticut is getting better service in some respects than she would with but one Station, and for the reason that both Stations are doing high class work on low class pay. But when in the future those who conduct these Stations fit their service to their pay, the result will be very different. The cherry is not enough for two good bites! Very sincerely yours,

S. W. Johnson.

(S. W. J. to J. G. S.)

Feb. 24, 1894.

Dear Sir,—The situation in this State, of Agricultural education and experiment stations, would require a considerable volume to set forth fully, and I fear I cannot make it intelli-

gible in the compass of a letter. The Sheffield Scientific School at the time of the passage of the Hatch Act, 1887, as in all its history previous to that time, was spending considerably more than its income—was, in other words, obliged to use every year more or less of the funds which it was extremely desirable to keep as a permanent investment. It was for several reasons thought imprudent for the School to set up a new Exp. Station. The Hatch act required, should the School claim its benefits, that land and buildings should be provided, for which the School had no funds. The Governing Board addressed a letter to the State Authorities waiving their claim to the fund (\$15,000) in favor of the State Exp. Station. Already the movement which culminated last year in making the “Storrs School” into the “Storrs College of Agriculture and the Mechanic Arts” was in the air, and those who engineered the latter movement secured the establishment in 1887 of the Storrs Ag. Exp. Station, having, so they claim, previously “tinkered” the Hatch bill to make a division of the Hatch fund possible in this State. This was a preliminary step towards that result which is set forth in the “Report of Committee on Education—National Grange B. of H., 1892” signed by Alpha Messer, and especially in the Resolution therein submitted, “That the National Grange Legislative Committee be instructed to continue their efforts for the passage of a law by Congress requiring the different states which have united the Agricultural and Mechanical Colleges with classical institutions to separate the Agricultural and Mechanical Colleges from the classical” etc. etc.

I mail to your address a package of five documents—four Reports of the Sheffield Scientific School and a paper on Recent Legislation—with references on covers to printed statements that explain the situation at some length and in some respects. I shall be happy to answer any further inquiries as far as I am able. Very truly yours,

S. W. Johnson.

(S. W. J. to W. E. B.)

New Haven, Conn., Mar. 31st, 1894.

My dear Sir—In answer to yours of 28th, I take the first leisure moment to say that we have decided to begin at once erecting a plant house, and shall be glad to learn of your acceptance of the proposal I made at our interview, which I may state more definitely as follows:—You to come on and take your residence in New Haven the 1st of May (or as soon as we can get ready to give you occupation), and work in the line of vegetation experiments and horticulture, for six months or until Nov. 1st. We cannot now make any plan for continuing the engagement beyond that time (Nov. 1st) but I hope that long before the six months have expired, the means will be found to make a permanent engagement should you and we find such engagement mutually satisfactory. The pay for the six months to be \$50 per month, paid on the last day of each month.

You would work under direction of Dr. Jenkins and myself. Dr. J. and I are in entire harmony and he is a very agreeable person to work with. No one else would interfere with your operations. I don't think there would be any difficulty in your getting away two or three times to New Hampshire. There will be some one to look after your work when needful. We have a pretty good Station Library, and there are others to which you could have access.

I think I have answered every point raised in your letter. If anything occurs to you for further inquiry I shall be glad to respond. Hoping to get your decision soon, so that should you conclude not to come we can negotiate with some one else in time for the season's work, I remain, Very truly yours,
S. W. Johnson.

(S. W. J. to E. H. J.)

Holderness, N. H., Aug. 20, 1894.

Dear Geheimer Rath,—I have been thinking about Horticulture, Greenhouses and Brother B. To do anything with

greenhouses this coming winter it will be needful to expend a thousand dollars \pm very soon. Doubtless we can do it, but we really ought to spend two or three, or more, thousand dollars in order to have a good plant. The method we have followed I am very tired of. We take a deal of trouble, serimp and go on tick, and finally get a good deal less than we ought to have. It will not be economical to put heat into our present house and build a cheap and small potting house, and then next year add another small house, and go on patching up and piecing out. If necessary, why we will do so of course, but I feel it would be better to stop where we are until the State has given us a good sized appropriation for enlargement and improvement of Laboratory and Greenhouse. Then we can go ahead in good shape.

Meanwhile, we must find occupation for Britton and prepare to carry the law-makers to the point of giving us \$20,000 \pm . . .

I will go on a collecting tour and get a mass of material, and see that there is enough to employ Britton and hold him until we can mature the greenhouse and Horticulture business. . . .

As preliminary to asking for appropriations would it not be well to get ready and send to all the important FAIRS this fall, a Station exhibit to interest and instruct the people?

I am thinking of coming home in the first week of September, and will help in this line of Chr. Endeavor. The things we can exhibit are:

1st. *Babcock test*, if there are any places where it has not been sufficiently shown.

2nd. *Back numbers of Reports and Bulletins* that are in our lumber room can be put in circulation in considerable numbers.

3rd. *Station Chemical and Mycol. Exhibit*. An abbreviation of,—or selection from the Ch. Exhibit we used to send around, but made attractive by *some simple expts. e. g.*

(a) Burn P and prepare "bone phosphate" and explain and prepare supers. (b) Burn K and explain potash, and show etc., the salts. (c) Show color tests for nitrates, and demonstrate its presence in soils and well waters. (d) Show photos (large!) of our work last summer and this on corn plants. (e) Exhibit Wagner's plates with explanations. (f) Show Fungus diseases with pictures, etc.

It would be important as far as possible to get Station work in such shape that all hands can attend the fairs and show up the Station.

Now I'll let you up and get my breakfast and mail this for your consideration. But it occurs to me and I'll put it down, that the Station might do well in some cases, or all where practicable, to have a special hour or hours appointed at the fairs for its *demonstrations* or talks, "*conferences*" of Babcock, etc. Avec l'hommage du cœur. Yours, S. W. J.

(S. W. J. to E. H. J.)

Aug. 25, 1894.

My dear Dr. Jenkins,—Yours of 22d expresses my sentiments better than I could do myself. . . . It seems to me that next spring we must enlarge the present glass house or build another, in order to continue and expand the fertilizer plant experiments. That is a racket that must be worked. If, *e.g.*, it will require \$1000 or \$800 to set up the winter horticulture, and if the \$1000 or \$800 is to come from our next year's regular income, it is a serious question which (heat or new house) we shall devote that \$1000 or \$800 to. But I need not discuss this further on paper now.

When do you intend leaving New Haven for Nantucket? (Don't get poisoned with their water in that ancient and fish-like island. At Siasconset, when I was there, all the drinking water came from one well, and I was sorry I couldn't drink whiskey!) . . . Yours, S. W. Johnson.

(F. H. S. to S. W. J.)

476 Boylston St., Boston, 28 July, 1894.

My dear Johnson,—I send you by mail a copy of a new edition of the old elementary chemistry which for many a year was part and parcel of my life. The inception of it—or, rather, that of the *methodized* laboratory experimentation which the book was made to help out—was probably out and away the most important act of my life. Why can't you spunk up and say some words about this book in the *American Journal of Science*? Trusting that you are as full of "rest" and vigor as a coiled spring, I am as always, truly yours,
F. H. Storer.

(S. W. J. to F. H. S.)

Sweet Ferns, Holderness, N. H. Aug. 8, '94.

My dear Storer,—Yours and the book were duly reed., I am grieved to think, nearly a fortnight ago. I read the book through the same day, but that feat broke my bank, or back or both, and I have not read or writ since. In fact I got overdone in April and since have been "holding on by the gills" only—came up here "mortal tired," and have been *exclusively* occupied with the endeavor to get up my muscle and improve the digestive ferments. I am hopeful that the affair will prove a success, but I am yet in the woods or at least in cop-pice, and bothered a good deal by tanglelegs and rampikes.

It will afford me keen pleasure to undertake the notice, and I will spunk up directly and let myself out for that job for all I'm worth. Yours faithfully,
S. W. Johnson.

(F. H. S. to S. W. J.)

476 Boylston St., Boston, 28 Sept. 1894.

Dear Johnson,—Prithce tell me—right off straight!—the name and address of the Sec. of the American Association for the promotion of Agricultural Science or, rather, I would

like to know where to apply for the purchase of their publications. I have an impression that Scovell is the Sec., but am not sure. Sincerely yours, F. H. Storer.

Wasn't that Lord Rayleigh work on the residue from air-nitrogen *great*?

(S. W. J. to F. H. S.)

Sept. 30, 1894.

—The Secy is Prof. Wm. Frear, State College, Pa.

I have not yet read anything but newspaper accounts of Rayleigh's work. We need an allotropic nitrogen or oxidable N-compound to connect chemistry with symbiosis! and need it badly, don't we?—

(F. H. S. to S. W. J.)

476 Boylston St., Boston, 1 Nov. 1894.

Dear Johnson,—You're a trump! I want you to accept my very best thanks—many and multifarious—for the "notice" in this month's number of the *Journal*. Never was publication more timely, for our publishers were in the very act of fretting under the jibes of the agents of rival publications, and were allowing themselves to lend an all too willing ear to such agents' assertions that the book is "too big for daily use."

I have been protesting right along (and a hard fight I have had of it) against the "trade" feeling that a text-book must be pared down to lowest terms, and have insisted that this country is now ripe enough to permit a reputable house to give over the peddling of white oak cheese and nothing else.

Last week I read for the first time what Hilgard said in 1882, at a time when I was much more dead than alive—about my (and your!) view of salt and lime in composts!! He handled his theme well. I acknowledge full satisfaction. Only I wish I had known of his explanation before reviewing my "Agric."

I have been interested, too, in a really noble research on petroleum which Maybury (of Cleveland) is carrying on. He confirms Warren right and left, and is doing himself great credit. It is a joy and a gladness to see an American chemist manhandle an American problem. Sincerely thine,

F. H. Storer.

(S. W. J. to F. W. F.)

May 22d./95.

My dear Sir,—I am very sorry that my answer to yours of the 17th inst. has been so long delayed, but I have had to look for more definite information than I possessed when it came to hand, and even now I cannot be quite as explicit as might be desired.

Various preservatives for fruits are nowadays employed with success. Among them *benzoic acid* or *sodium benzoate* (which latter placed in contact with acid fruit-juices, yields free benzoic acid) is, I believe, the best. Sodium benzoate is most convenient, as it dissolves readily (benzoic acid but slowly) and is otherwise unobjectionable.

How much or rather how *little* to use, I cannot state precisely. While there is no evidence, so far as I know, that benzoic acid or benzoate are in any way injurious when taken into the digestive tract, in small quantities, it is probably important that they should be used in minimal amount, since otherwise they *may* interfere with health.

It appears to be well authenticated that benzoic acid occurs in various edible plants and, if such be the fact, the use of this acid as a preservative is thereby justified. But the quantity naturally existing in edible vegetable substances is doubtless very small, an indication that it should be sparingly employed. The cranberry, which has remarkable keeping qualities, is stated to contain benzoic acid, and it is not unlikely that huckleberries also contain it or a very similar acid.

The published statements that I have access to are rather

vague, but I gather that one part of benzoic acid or sodium benzoate by weight will be ordinarily sufficient for 500 to 1000 parts by weight of fruit.

The pineapple contains a powerful digestive agent, *bromelin*, which Professor Chittenden has investigated, and which is doubtless a principal reason of the salutary quality of that fruit. This vegetable-pepsin is destroyed by a boiling heat, and therefore it is desirable to preserve the pineapple uncooked. Benzoic acid, I believe, does not in the least impair the digestive power of bromelin.

I should suppose that the sliced or shredded pineapple, sprinkled with a little sugar and with the benzoate, and put into bottles closed with clean corks or into fruit-jars, would *ordinarily* keep without further trouble. I say *ordinarily*, because of the microbes (fungi, bacteria and what not) which occasion the moulding, fermentation or putrefaction of fruits, the name is legion, and some are vastly more hard to kill or suppress than others. It may happen, therefore, that a proportion of benzoic acid which will answer for this year, or in this place, or with the pineapples now in market, will be insufficient next year or elsewhere, because of a difference in the bacterial seeding or inoculation.

It is important that each jar of fruit should receive its proper amount of benzoate. I should advise either to have weighed out (by the druggist) and placed in each jar, just the dose needed and add to each the amount of granulated sugar required for sweetening, or, if a considerable batch of fruit is treated at once with a single dose of benzoate, I should sweeten to taste with dry sugar, and keep the whole some days in one large well-covered vessel until the fruit has yielded a goodly amount of juice and has thereby become impregnated with the preservative. The former plan is preferable since it is desirable to avoid exposing the fruit unnecessarily to seeding with the bacterial germs wherewith air is commonly loaded. Yours very truly,

S. W. Johnson.

(S. W. J. to W. E. B.)

Holderness, Sept. 17, 1895.

My dear Mr. Britton,—I send by Am. Express this morning a box of *Apios Roots* with *soil containing tubercles* and, it is to be presumed, well stocked with the *bacteria and bacte-roids* needful to enable this leguminous-tuberous plant to supply itself with Nitrogen, Argon, Helium and all other gaseous food. It is just as well, if not better, *not to talk about* this plant and its culture. I would say and show nothing—more than cannot be avoided—for 3 years to come. I would give the tubers a chance to do their best in garden and greenhouse, with and without supplies of N in fertilizers. Take care of all the earth sent so that the bacteria may not be lacking. I would plant out a row of the tubers in rich garden soil. They flourish here in a thicket of raspberry bushes, sumachs, etc., but of course climb well into sunshine. Yours, etc.

S. W. Johnson.

Baked, the tubers are well-tasting and haven't poisoned me. The dose, however, was small like the tubers!

(S. W. J. to J. W. W., CHAIRMAN OF AGRICULTURAL
COMMITTEE OF CONGRESS.)

March 1896.

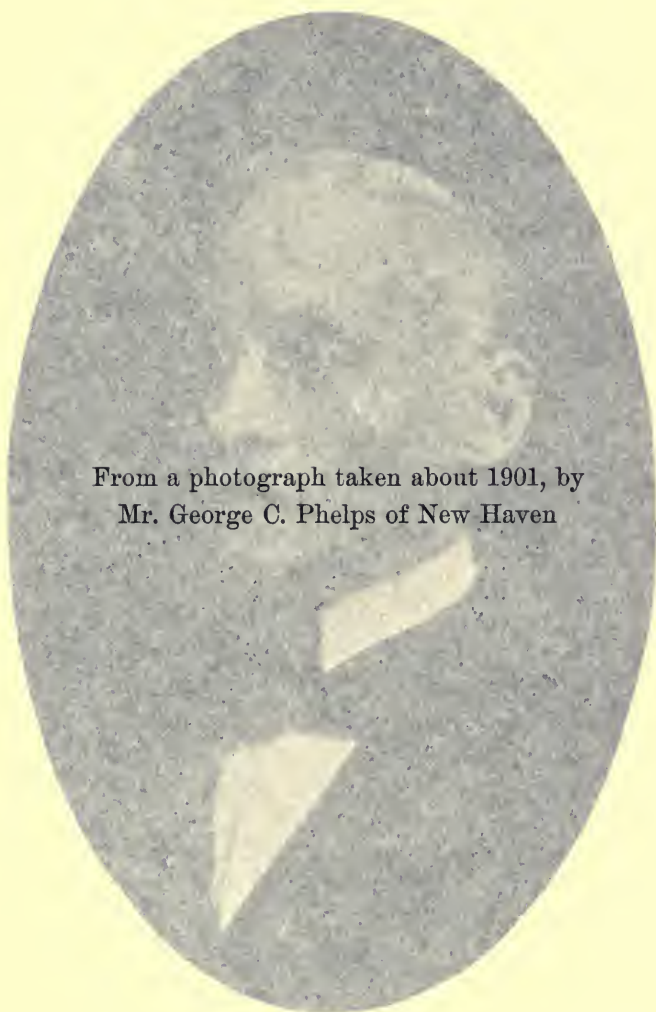
Dear Sir,—The Bill H. R. 6729, of which you request my opinion, I consider objectionable because it puts upon the *Experiment Stations*, or legalizes, the raising by them of seeds, bulbs, etc. etc. in quantity for sale, an occupation which is contrary to the objects for which Exp. Stations were established. I do not regard such furnishing of seeds, bulbs, etc. etc. by *Agricultural Colleges* as objectionable, since work of that kind may be made serviceable in instruction and in giving employment to needy students, but that the Secretary of Agriculture be *directed* to purchase *all* seeds, bulbs, trees, etc.

etc. which are to be distributed, from Experiment Stations or Agricultural Colleges, *provided* etc. etc. is, in my opinion, totally wrong and preposterous. I have the honor to be
Yours very truly, S. W. Johnson.



REFERENCES

From a photograph taken about 1891, by
Mr. George C. Phelps of New Haven



From a photograph taken about 1901, by
Mr. George C. Phelps of New Haven

CHAPTER VIII

EMERITUS

In 1896, Professor Johnson became professor emeritus of agricultural chemistry in Yale University. He retained the office of director of the Agricultural Station, being relieved of all save literary and advisory duties by the vice-director, Dr. Jenkins, who had worked in loving and considerate harmony with him for so many years that this gradual relinquishment of authority caused little sadness.

When, in 1900, Professor Johnson, realizing that he was no longer equal even to his light share in the Station's administration, resigned the office of director of the institution he had built up; he accepted, at the urgent request of the Board of Control, the position of advising chemist which they created for him. After a year, however, he again asked them to accept his resignation, thus severing the last link that connected him with scientific activities. His letters of this period depict his philosophical acceptance of the ever-narrowing environment of old age:

(S. W. J. TO A NIECE.)

[December 1896] Your warm invitation to cool Saint Paul I should be most happy to accept, but I fear he'd cool me! Then too, I haven't any tickets for the "Limited" left, in fact I'm very limited myself and can't raise enough to get away from home unless I tick it. But going it on tick is expressly worse than riding on a rail!

In one of your letters (to which kindly consider this to be the answer) you referred to a meeting of the "A. A. A. C. and E. S." which it was hoped might be held at St. Paul in August last. I suppose you know that said meeting was not held *there* or anywhere *then*!

But the meeting of that A. A. A. etc. etc. etc. was held at Washington about a month ago,—and I went to Washington and staid a week, and thought how much more pleasant it would have been were I at St. Paul having a good time.

Though I don't go at the ringing of the bell any more, and am not laboring to slice information so thin that it can be passed through the skull-sutures into the brain of the average young man who goes to school, I have enough to keep me busy, and am indeed very busy with the Exp. Station and with the several little sciences that I have struggled with for half a century.—

(S. W. J. TO A GRANDNIECE.)

Dec. 3d, 1896.

My dear Sara,—I much regret that I have so long delayed answering your very nice letter written from your Grand-mamma Easton's house last summer, a year ago and more. I must not only apologize for this neglect, but must explain that I was very brain-tired when the letter was received, and quite unable to make an appreciative answer.

Your question as to the comparative brightness of Jupiter and Venus, you may very likely have been able to answer for yourself during the 15 months that have elapsed since it was proposed to me. Nevertheless I will have my little say, though I am more versed in things terrestrial than in those celestial nor have I seen either of the heavenly bodies you inquire about for a long time. But when I was a school-boy I "looked after" the stars occasionally, very much as I "fetched up the cows" or "tended the twins," and although all these varieties of activity are now and long have been to

me as lost arts, I believe that I remember on many occasions to have seen Jupiter and Venus walking out together of a pleasant evening arm-in-arm as honest family folks do, now and then, and just as Dr. and Mrs. McD. do, I dare say; and I recall very distinctly that Jupiter looked quite inferior to Venus, as I don't doubt the Dr. is quite outshone by your brave little mamma. To be sure, both Jupiter and the Dr. are larger than their spouses, but the latter are both nearer the center of their respective solar systems, and both I suppose "keep the inside track" as they perambulate the zodiac, and for these or other satisfactory reasons, they—Venus and Lois—are far more brilliant than any creature can be who goes on the street in a black hat and tan gloves. Yes, Venus and her milliner are a long way ahead of Jupiter, who I fear gets *his* clothes secondhand, no matter who Dr. McD's tailor may be.

Now, if what I have written shows any competence to give information on matters astronomical, I fear that your botanical quiz will bury me out of sight.

Your second question is—Why does the sensitive plant shut up when we touch it? That is a very difficult question to answer if one wishes to tell concerning "*the truth, the whole truth and nothing but the truth.*" I can give a variety of answers, *e.g.* The sensitive plant shuts up for the same reason that the naughty boy doesn't "shut up." It shuts up because it can't help it. It shuts up because it was made to shut up! It shuts up because it can't stay open! I fear that you don't find these answers satisfactory. Now I will give you an answer that if not satisfactory to you will be perhaps conclusive, and it will be a pleasure to think of something besides the sensitive plant. This sublime answer is, "I don't know!" *But*, the first answer, above given, in which the sensitive plant and the noisy naughty boy are classed together, has a large measure (say a milk-panfull) of truth in it. The boy and the plant have in all their live young parts a good supply of what *biologists* call *protoplasm*. Now, assemble

your Papa, your Mamma and all the Dictionary that has Pr words in it, and get a working knowledge of the words underscored above. That done, we go on to remark that protoplasm is always, everywhere under favorable circumstances sensitive, and capable of motion when touched, *i.e.* when moved, and can move of itself. The sensitive plant moves when you move it, the boy keeps moving when the *motion* is made and seconded to stop his "moving, any more in that way, just now!" The sensitive plant moves because its protoplasm moves, and that's what's the matter with the boy!

Now you will ask why don't other plants move? The correct answer is "they do move"! But most common plants move much less quickly and far less extensively than the sensitive plant does. Such animals as live in a hardshell house that they carry around with them, like the turtle, armadillo and alligator, move much less noticeably than the small boy whose awful dad has to build, and often [*repair*], the cloth-houses and the brick houses that said s. b. dwells in when he does not go a-swimming. So the clothes in which the modest mimosa-protoplasm is dressed are much less snug-fitting—have not so much whalebone, buckram, leather and pilot cloth as coarser, vulgar plants like for their garments.

There are many plants that are sensitive enough to make some slow motion when touched roughly. One such plant is a common "weed" about New Haven, with handsome yellow flowers and leaves very like those of the "sensitive plant" you have asked about. Many—perhaps most, plants when seen under a microscope are found to have visible motions going on, in their insides, somewhere, especially in the young parts where they are not too "hide bound." The sensitive plant, like the irrepressible boy, becomes less sensitive as it grows old. The boy, you know, when he gets to 90 or 100 years old isn't more sensitive than a burdock or a pumpkin.

In the sensitive plant the leaves are arranged like this sketch, where *a* shows the untouched and *b* the touched leaves. From *c* I have drawn a line to the point where the four leaves

d, *e*, *f*, and *g* are joined to the main leafstalk, *s*; at that join the four leaflet stalks (of *d*, *e*, *f* and *g*) are enlarged to a sort of cushion and if this cushion is touched gently on the under side, the leaflet, either one of the four primary (Dictionary: *primus*: prime both of us!) or any of the many secondary ones, will move, but the same kind of touch on the upper side will not cause movement. It's just the reverse with the boy. Touch him gently (with a pin's point on the under side) and he will jump. I know it for I've tried it and had it tried on, on the contrary, rap him on the noddle and his backbone will stiffen and all the mule in him will come to the front!



Now, my dear Sara, behold how long a letter I have written you with my own hand, as St. Paul says, and how much better I should feel and be if I wrote many long letters to nice young ladies, but it's rather late in life to begin now, and I shall be obliged to cut this short or buy more paper!—

(S. W. J. TO E. E. J.)

Gray Birches, Holderness, June 2d, 1906.

Dear Elizabeth,—I take pleasure in informing you that ——— and I are very comfortable, having passed through a long East-wind storm of rain and cold, and come out into

sunshine and a new green world of beauty and bird music. . . . I have been busy as a bee "doing stunts." Am now fixing the screens on Tom's balcony window, and have looked at small nails in the sunshine until I can hardly see the letters I am now making. . . . I have just returned from accompanying Fred and Mary to Ashland on their way to New York. They reached Gray Birches Sat. night at 10 o'clock. . . . We had a very pleasant quiet visit. . . . In the afternoon Fred and I walked down my path to the lake. We inspected all the 4 houses (bath and boat) on our beach, and walked back by the easy public road.

We found the purple lady's-slipper (or moccasin flower) growing near the Bunce cottage and in bloom, also abundance of the *Polygala paucifolia* in the lower woods. I boxed 3 lady's-slipper plants for Mary to carry home and cultivate. She had never seen it before. . . . With love to the home friends in 54 and 52. Yours,
S. W. J.

(ORIGINAL DRAFT OF A LETTER TO THE TRUSTEES AND
FACULTY OF LOWVILLE ACADEMY.)

June 19, 1908.

Gentlemen,—Your very kind invitation to attend the Centennial Celebration of the Academy under your charge was duly received, and I have delayed my answer in the hope that I might find it possible to be with you on that occasion. . . . Were I 20 years younger I should not hesitate to take a night train for Lowville, but the family council vetoes such an undertaking, and I most regretfully feel compelled to forego the pleasure of enjoying your Centennial festivities and solemnities. My life-companion, whose name, as Miss E. E. Blinn, closes the list of preceptresses, given on page 76 of the volume entitled "Lowville Academy Semi-Centennial," and who filled that position for 4 years (instead of 1 year, as stated in Dr. Hough's historical address, p. 76), desires to be remembered to any of her students or acquaintances of the old days,

who may be present with you at your celebration of the completion of a full century of academic achievement.

I have a strong affection for your Academy and for the pleasant village where I spent the larger part of six school-years (1840-1846) under the direct supervision of Mayhew, Norton, and Moore, all thorough scholars, inspiring teachers, in every way most friendly, most helpful, most exemplary, most companionable.

The class-rooms where they taught always were pleasant places when lighted up by their cheerful presence, and the atmosphere that environed them seemed full of generous and sympathetic goodness. Those class-rooms not infrequently became places of entertainment, and the strain of closely following the rigid demonstrations of logic or mathematics, or of compelling some idiom of a dead language to resuscitate, was relieved by a flash of wit or a thrust of sarcasm that may have stung slightly, but deservedly, and made a sensation that delighted the entire town of Lowville.

Wishing for you a most agreeable and profitable celebration, and for the Lowville Academy perennial endurance and ever-growing prosperity, I am, Very sincerely yours,

S. W. Johnson.

Books accumulated during sixty years filled to overflowing three rooms of his dwelling. When impaired vision precluded further serious work, Professor Johnson dismantled his library. He sent an unusual collection of old agricultural books and journals as a gift to the Connecticut Station. While director he had completed the station's files of State and Federal publications on agriculture; in the years immediately following his retirement he assembled a nearly complete duplicate set. This he now gave to the Yale University Library. A large number of scientific journals on his shelves was added to the library of his son-in-law.

Having thus placed the books that seemed to be so absolutely a part of his own life where they would still be in daily use, he divided his time between his carpenter shop and his study, still book-lined, where he followed certain lines of research in the current journals and enjoyed the daily discussions held on the progress of the work on plant-proteins going on in the laboratory of the Connecticut Station. He still read to some extent, current literature often, but most often such books as Thomson's "History of Chemistry," Liebig and Wöhler's "Briefwechsel" and Storer's "Agriculture." The "Oxford Book of English Verse" was never far from his hand; most heartily enjoyed were "Prayers, Ancient and Modern" and a thin white volume that bore the name of "Fiona Macleod." While apparently absorbed in these diversions, he nevertheless always laid down his book with alacrity to answer patiently and clearly the many questions brought to him concerning the history of science and problems presented in the development of Modern Chemistry, the birth and growth of which had been so nearly coincident with his own professional life.

Attacks of pneumonia, in 1906 and 1907, left him very frail. He accompanied the family to New Hampshire in the summer of 1908; in June, 1909, he decided to remain quietly in New Haven, planning for his summer's amusement field experiments that he had "never before had the time to undertake." He also set in order and refitted his private laboratory; where he undertook to isolate the citric acid which a German chemist, some years before, had reported to be present in milk—an observation that up to that time had not been confirmed.

(S. W. J. to L. F. E.)

New Haven, July 5th, 1909.

My dear Fred,—Last week Tuesday your Aunt Elizabeth and Lily with Miss R., a trained nurse, took night train at 10 P.M. and reached Ashland at 8 A.M. Wed'y morning. Tom and the cook followed on Friday.

They write that the journey was comfortable and they are enjoying the top of Shepard Hill very much. I am staying here and feel like continuing to stay. The rest are booked to go to Holderness on the 8th. Tom will return soon and be here most of July. Your aunt and I are getting well along on the back track; 2d childhood and renewed babyhood are making both of us amusing to "the rising generations." But I have one compensation. The thermometer at 80° just suits my feelings, and I can slosh around on New Haven's dead levels much better than I can get over the rocky hills of the old Granny State, and I can now look back on my 4108 weeks of experience of this wicked world with the comfortable reflection that I have not much longer to trouble it or be troubled with it. . . .

(S. W. J. to E. E. J.)

July 10, 1909.

Dear Elizabeth,— . . . I have got into very old clothes, and am running the shop on full time and getting up my muscle. I have kept the grapes in good shape, and shall begin bagging the clusters this P.M. I am trying to put my 3 rooms into manageable condition—so that I can find what I want and can't find the rubbish which has nearly swamped the furniture, floors and chairs.

Say to Miss R. that I hope she will gradually aid to develop your (and her) muscle,—that I shall hear of your going down to the Lake and up Shepard Hill back again on foot at least once daily. Bye Bye,

S. W. J.

Professor Johnson was prostrated by a severe attack of angina pectoris on July 13, and passed peacefully away on July 21, 1909, his mind occupied almost to the last moment with interesting problems of the noble science with which in boyhood he had linked his fortunes.

A fitting close is the recorded estimate of pupils who are today his successors in the work:

“An ardent enthusiast in research work. He was so modest and unassuming that he frequently did not get credit for what he really was. He did not seem to feel that he was blazing a trail in experiment station work in this country, although such was really the case.”

“He not only inspired an interest in the problems of agricultural science, but by the example of his own work furnished an ideal of true scientific research which has been a standard ever since.”

“The Agricultural Stations of the country will be the everlasting memorial of his services. . . . His life rounded to its close, with a great service done to his state and country and done quietly without observation, just as a tree ripens its fruit.”

APPENDICES

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SUPERPHOSPHATE OF LIME

[First printed in the *Country Gentleman* in March, 1853.]

This manure, suggested by Baron Liebig about ten years since, has come into very extensive use in England, and, from present indications, will soon figure very largely in American husbandry. It is unnecessary here to allude to the success that has attended its application, as agricultural readers well know.

The enterprising farmer who proposes to himself its use, naturally inquires whether it is cheaper to manufacture it on his own premises, or to purchase it.

To assist in answering this question, I shall give the results of analyses of two articles now in market, namely: "M——'s" and "D——'s."

It will be best to examine to some extent the chemistry of the subject, in order to understand what constitutes the value of Superphosphate of Lime.

There are two compounds of lime and phosphoric acid, which are of agricultural interest, viz., the neutral phosphate, which we shall call simply *phosphate*; and the *super-phosphate*. The first, when pure, contains in 100 parts—Phosphoric acid, $48\frac{1}{2}$; Lime, $51\frac{1}{2}$.

It is the chief earthy ingredient of bones, and that to which they mainly owe their efficacy as a manure. It is well known, that although bones are highly useful when applied to the soil in an unbroken state, they become far more valuable if reduced to small fragments, or better still if ground to dust. This is because nothing can enter the plant in a solid form. All that a crop absorbs through its roots, must be dissolved in water. The phosphate of lime, as it occurs in bones, is only very slightly soluble in water, and is of course very slowly presented to the plant. The more finely it is divided,

or pulverized, the more surface it exposes to the action of water, and the more rapidly it dissolves. By grinding, it is only possible to reduce the bones to a gritty dust, fine perhaps to the eye, but still coarse when seen under the microscope. Chemistry furnishes a cheap means of extending the subdivision to a very great degree.

And this brings us to the superphosphate. This compound consists, in 100 parts, of—Phosphoric acid, $71\frac{1}{2}$; Lime, $28\frac{1}{2}$.

As prepared for agricultural purposes, it is largely mixed with other substances, as the analyses show. Unlike the phosphate, it dissolves easily in water. It differs in composition, from the phosphate, only in the proportion of its ingredients. If we add a certain amount of phosphoric acid to the phosphate, we shall obtain the superphosphate. It may also be procured by taking away lime from the phosphate. In practice, we do the latter. If we add to bones, one-third their weight of sulphuric acid (oil of vitriol), a portion of lime quits the phosphoric acid and unites with sulphuric acid, forming sulphate of lime (gypsum); while the phosphoric acid, thus set free, combines with the undecomposed phosphate, forming superphosphate.

Let the reader add a tea-spoonful of superphosphate to a tumbler half full of water, and after a little stirring, allow it to settle, and pour off the clear liquid into another tumbler. (If no superphosphate is at hand, use instead of the liquid just mentioned, strong vinegar in which some pieces of bone have stood for a few days.) Then prepare a solution of saleratus, or soda, in water, and pour it gradually into the first liquid. Presently a white cloud, or *precipitate*, as chemists call it, will be formed; at the same time the liquid will foam like soda-water, from the escape of carbonic acid gas.

This white cloud is *precipitated phosphate of lime*, and is the same as bone-earth phosphate except that it is inconceivably finer than can be obtained by any mechanical means. The particles of bone-dust will not certainly average smaller than 1-1000 of an inch, while those of this precipitated phos-

phate are no more than the 1-20,000 of an inch in diameter, as I have just been informed by a friend skilled in the microscope, who has measured them at my request. Since the particles of the precipitated phosphate are so very much smaller than those of the finest bone-dust, we can understand that their action as a manure is correspondingly more rapid.

In fact, the application of superphosphate to the soil is always speedily followed by the formation of precipitated phosphate; the iron, lime, potash, etc., of the soil, having the same effect as that produced by the saleratus or soda, in the experiment just described.

The use of dissolving bones in sulphuric acid is, then, not to furnish the plant with a new food, but to present an old dish in a new shape, more readily accessible to the plant.

In addition to the advantage of *subdivision* thus presented, Prof. Way, of the Royal Ag. Society of England, insists upon another, viz., *distribution*. This may be illustrated as follows: If a quantity of bones be acted upon by sulphuric acid, thus forming superphosphate—and if a part of this have chalk, lime, or ashes mixed with it before use, while the other portion is directly applied, in both cases precipitated phosphate will be furnished to the soil. The *subdivision* will be equal, but the *distribution* will be unlike. In the first case, the ready formed phosphate is imperfectly mixed with the soil, by the rough mechanical operations of cultivation. In the last instance, if the superphosphate is scattered on the surface, it is unaffected until a rain falls upon it. Then the superphosphate dissolves, and trickles or soaks down into the soil, meeting here with a particle of lime or potash, and depositing a particle of phosphate, traveling on a little way and depositing another, and so filling the whole soil with the precious fertilizer.

It seems then, that it is important not only that the superphosphate be *made*, but that it *remain* as such until strown on the soil.

The reader's attention is now directed to the analyses of

several samples of superphosphate. No. 1 is a mean of the analysis of four superior English samples. No. 2, analysis of "M——'s." No. 3, "D——'s" (mean of two according analyses), and No. 4, mean of five average English samples. Nos. 1 and 4 by Prof. Way, Nos. 2 and 3 by myself.

No. 2 is an authentic sample furnished me by Mr. Hoyt, of New Canaan, Conn. No. 3 I procured at the New Haven Agricultural Store.

	No. 1	No. 2	No. 3	No. 4
Moisture	8.04	4.54	6.18	5.67
Organic matter and Salts of Ammonia	18.01	15.80	9.20	5.71
Soluble Superphosphate of Lime . .	14.80	14.89	8.34	9.99
Insoluble Phosphate	10.91	20.98	29.63	9.94
Sand	6.12	1.48	8.83	6.24
Sulphate of Lime (gypsum) . . .	36.02	36.93	31.72	
Free Sulphuric Acid		5.06	5.71	42.44
Magnesia, Soda, and undetermined sub- stances32	.39	
	100.00	100.00	100.00	100.00
Ammonia yielded by the dry matter .	3.07	2.74	1.39	1.32
Precipitated phosphate yielded by the superphosphate	21.80	21.95	12.28	14.72
Total amount of phosphate after mix- ture with the soil	32.71	42.93	41.91	24.66

Bearing in mind that the value of this manure almost entirely depends on its superphosphates and its ammonia, it will be seen that "M——'s" is in no respect inferior to the best English samples, while it contains in addition 10 per cent of insoluble phosphate of lime, that will be permanently valuable after the first effect is over.

"D——'s," according to my analysis, (which I have perfect confidence in, all the important substances being twice determined,) is six per cent behind M——'s in superphosphate, and has but about half the ammonia. The amount of *precipitated phosphate* which will be produced when these

manures are mixed with the soil is represented in the last line—nearly 22 per cent in M——'s, and 12.3 per cent in D——'s. It should be observed that the total amount of phosphate is very nearly alike in M——'s and D——'s. This is obtained by adding the *insoluble phosphate* to the *precipitated phosphate*. D——'s is therefore equal to M——'s in final effect, so far as phosphates are concerned, yet it is quite inferior in *immediate* value, and should be afforded at a less price, or else more carefully made, so as to raise the amount of *superphosphate*.

D——'s compares well with English average specimens of No. 4.

These are both valuable manures, and undoubtedly M——'s is cheap enough at the present price, \$50 per ton, if its quality is maintained as good as my analysis represents. Still we may hope that as good an article may be purchased, before many years, at a much less price. This can not be expected until the consumption is greatly increased, and more competition arises among manufacturers.

It is proper to state that I have no connection with the parties concerned in the manufacture or sale of these manures; and receive no compensation for the mouths' labor expended upon the analyses, except the satisfaction of contributing to the advantage of purchasers.

It should be borne in mind that the value of these manures may be found to vary greatly at different times, and the farmer can only be fully protected from unprofitable expenditure, by the frequent publication of analyses made upon different samples.

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